SOIL SURVEY OF

Barton County, Missouri

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Missouri Agricultural Experiment Station

Issued November 1974

Major fieldwork for this soil survey was done in the period 1965–68. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1969. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Barton County Soil and Water Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, woodland, and wildlife habitat; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Barton County are shown on the detailed map at the back of this survey. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and woodland group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and the woodland groups.

Foresters and others can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Barton County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Additional Facts About the County."

Cover: **Minimum tillage and double cropping are practiced on Barden silt loam, 1 to 4 percent slopes, in foreground, and on Parsons silt loam, 0 to 1 percent slopes, in background. Green beans are grown after small grain in most years, when supplemental irrigation is feasible.**

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

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SOIL SURVEY OF BARTON COUNTY, MISSOURI

BY HAROLD E. HUGHES, SOIL CONSERVATION SERVICE

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE MISSOURI AGRICULTURAL EXPERIMENT STATION

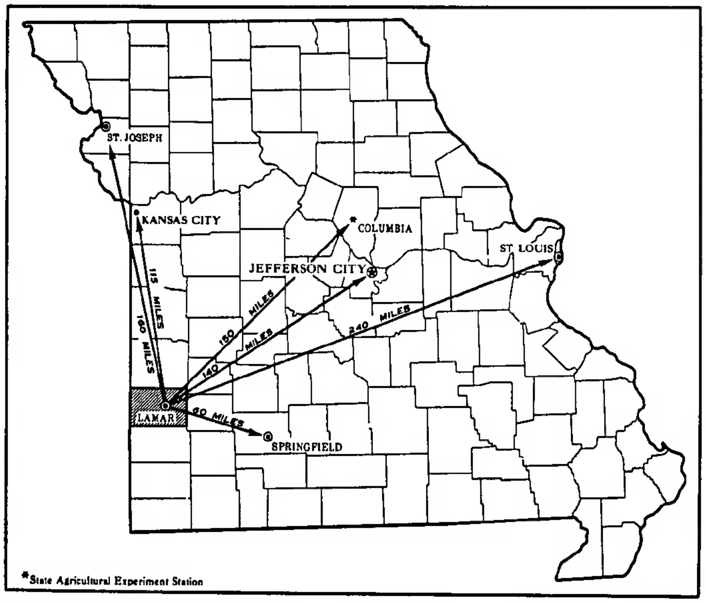

Figure 1.—Location of Barton County in Missouri.

BARTON COUNTY is in the southwestern part of Missouri (fig. 1). The land area is about 594 square miles, or 380,160 acres. Lamar, the largest town and the county seat, is in the east-central part of the county. In 1960, the population of the county was 11,113. The population of Lamar was 3,608.

The county is part of two physiographic regions. Most of it is within the Cherokee Prairies. The western edge of the Ozark Border extends into the southeastern part of the county. The Cherokee Prairies are underlain by acid micaceous shale and sandstone. Limestone bedrock and cherty soils mark the Ozark Border. Farming is the principal enterprise in both regions, and the type of farming in each is very similar.

Almost 90 percent of the land area was in farms in 1964. Cash-grain farming is dominant on the broad, nearly level and gently sloping plains on uplands. The major crops are corn, wheat, soybeans, and grain sorghum. Other upland areas mostly have regular to somewhat broken and stronger slopes. In many places the slopes border the major streams and are partially timbered. Most of these areas are in grass and are well suited to grazing. Here, farming is more diversified. The cover and use of the bottom lands vary from place to place.

Upland slopes of more than 2 percent and long slopes of more than 1 percent are susceptible to erosion if cultivated and not protected. Most of the other upland areas are susceptible to erosion or droughtiness, or both. Wetness limits the use of the bottom lands and a minor part of the uplands.

Much of the bottom lands, especially soils of the Hepler series, has potential for development and intensive cultivation. The clearing, drainage, and flood control needed are feasible and practical in most places. Soils of the Radley, Verdigris, and Cleora series and other soils in areas that are not readily accessible are well suited to quick-growing shortleaf pine or other high-value trees such as walnut. Under supplemental irrigation, most of the bottom lands, much of the nearly level soils, and some of the gently sloping soils on uplands have a good potential for the intensive cultivation of high-value vegetable and field crops.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Barton County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*8*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer,

[1] Italic numbers in parentheses refer to Literature Cited, p. 74.

all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Bolivar and Liberal, for example, are the names of two soil series. All the soils in the United States that have the same series are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Hector fine sandy loam, 5 to 14 percent slopes, is one of several phases within the Hector series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Barton County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Hepler-Radley silt loams is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Lanton and Verdigris silt loams is an undifferentiated soil group in Barton County.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Mine pits and dumps is a land type in Barton County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Barton County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Barton County are discussed in the following pages.

1. Liberal-Collinsville-Barco association

Shallow to moderately deep, moderately well drained to well drained, gently sloping to moderately steep soils of the uplands; formed under grass in sandstone and shale residuum

In this association are nearly all of the watershed areas of Dry Wood Creek and about 30 percent of the western upper reaches of Little Dry Wood Creek. The high, wide divides and low benches are not in this association. The

landscape in most places is characterized by somewhat broken, gently sloping, rounded divides that have sloping or moderately steep sides and are adjacent to the stream valleys. In some places one or more large mounds surrounded by gentle foot slopes and nearly level benches are common (fig. 2). Most of this association is in the northwestern part of the county. The association occupies about 10 percent of the county.

Liberal soils make up about 28 percent of the association; Collinsville soils, 28 percent; Barco soils, 24 percent; and Parsons, Barden, and Summit soils, 10 percent. The remaining 10 percent of the association is mostly Radley, Verdigris, and Hepler soils on bottom lands.

Liberal soils are moderately well drained and have a surface layer of very dark grayish-brown heavy silt loam about 7 inches thick. The subsoil is silty clay loam in the upper part and silty clay in the lower part. It is mottled brownish, reddish, and grayish. Depth to shale is 40 to 60 inches.

The Collinsville soils are well drained and have a surface layer of dark-brown fine sandy loam 10 inches thick. The subsoil is dark yellowish-brown gravelly fine sandy loam about 3 inches thick. Depth to bedded sandstone is less than 20 inches. These soils are stony in places. Bedrock crops out in some areas of both the nonstony and stony Collinsville soils.

Barco soils are well drained and gently sloping. The surface layer is very dark brown loam about 11 inches thick. The mottled, brownish, friable subsoil ranges from loam to sandy clay loam. Depth to bedded sandstone is 20 to 40 inches.

Parsons, Barden, and Summit soils are nearly level or gently sloping on benches and foot slopes near drainageways.

Moderately well drained Radley and Verdigris soils are in low, narrow meander belts near stream channels. The somewhat poorly drained Hepler soils are on the higher and somewhat wider flood plains.

Considerably more than one-half of this association is in native grass or improved tame grass and is used for hay or pasture. Stony areas of Collinsville soils are idle or are used for pasture. Small grain and, to a lesser extent, sorghums, corn, and soybeans are grown on a large acreage. General livestock and grain farming are the main enterprises in this association.

Most of the soils of the uplands and bottom lands are

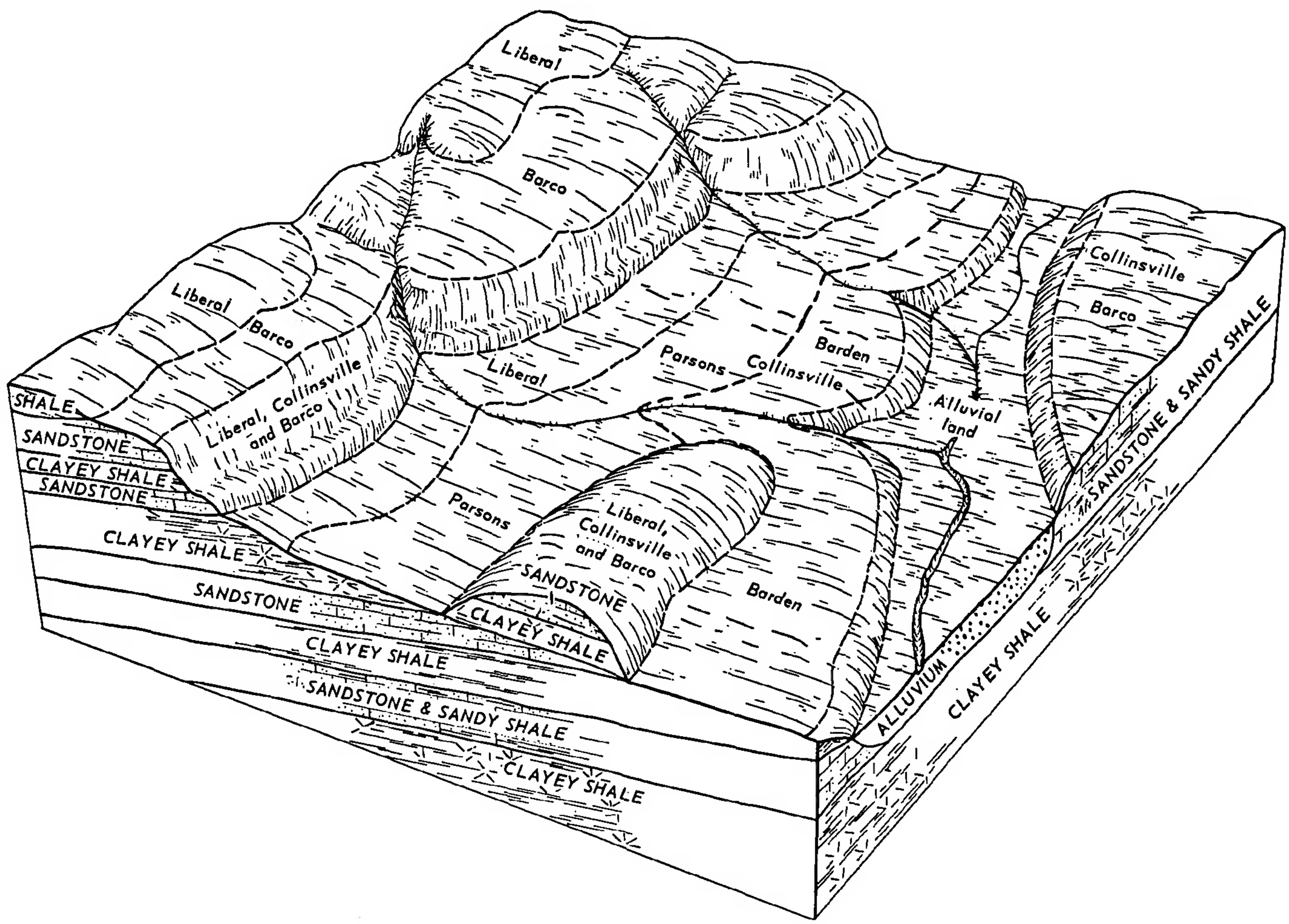

Figure 2.—**The major soils in the Liberal-Collinsville-Barco association, showing their general location on the landscape, the material in which they formed, and their relationship to low bench positions of the Parsons-Barden association.**

medium or low in fertility, and the bottom lands are subject to occasional or frequent overflow. Erosion and droughtiness in the uplands and wetness in the bottom lands are major limitations to the use of the soils in this association. A major part of the vast strip-mined areas in the county was in this association before it was stripped for coal.

2. *Parsons-Barden association*

Deep, somewhat poorly drained and moderately well drained, nearly level and gently sloping soils of the uplands; formed under grass in shale residuum

This association mostly consists of the high, wide divides that separate the watersheds of the major streams in the county (fig. 3). Minor acreages are adjacent to the flood plains of major streams on low benches. This association occupies about 47 percent of the county.

Parsons soils make up about 48 percent of the association; Barden soils, 32 percent; Helper-Radley silt loams and Breaks-Alluvial land complex, 15 percent; and Barco, Collinsville, and Liberal soils, the remaining 5 percent.

The Parsons soils are somewhat poorly drained, and the Barden soils are moderately well drained. Soils of both series are nearly level and gently sloping, and they are acid. They formed in shale residuum that is thinly mantled with loess or old silty alluvium in some places. Most of the Parsons soils are nearly level and on the higher, wider divides; the Barden soils are dominantly gently sloping and on the sides. Soils of both series border the U-shaped drainageways that dissect the landscape.

Parsons soils have a surface layer of very dark grayish-brown and dark-gray silt loam about 8 inches thick. The subsurface layer is grayish-brown silt loam that has platy structure and an abrupt lower boundary. The upper part of the subsoil is very dark grayish-brown to dark yellowish-brown clay about 12 inches thick. It has many dark-red mottles. The lower part is brownish and grayish silty clay loam about 22 inches thick.

Barden soils have a surface layer of very dark grayish-brown silt loam about 11 inches thick. The subsoil is mottled and about 45 inches thick. The upper part of the subsoil grades from dark-brown, friable silty clay loam to yellowish-brown, firm light silty clay. The lower part is brownish and grayish, firm silty clay loam.

Hepler-Radley silt loams and soils of the Breaks-Alluvial land complex are in upland drainageways. The Hepler-Radley silt loams are in narrow bottoms downstream, and the U-shaped, entrenched drainageways in the Breaks-Alluvial land complex are upstream. This complex consists of breaks with scarped edges; small contiguous, severely eroded areas of Parsons, Barden, and Barco soils; and very narrow bottoms of Hepler-Radley silt loams. Uplands and bottom lands are about equal in acreage in the complex.

Barco, Collinsville, and Liberal soils are in the uplands. They are mainly on breaks and rounded knobs. The shallow Collinsville soils and the moderately deep Barco soils formed in material weathered mainly from

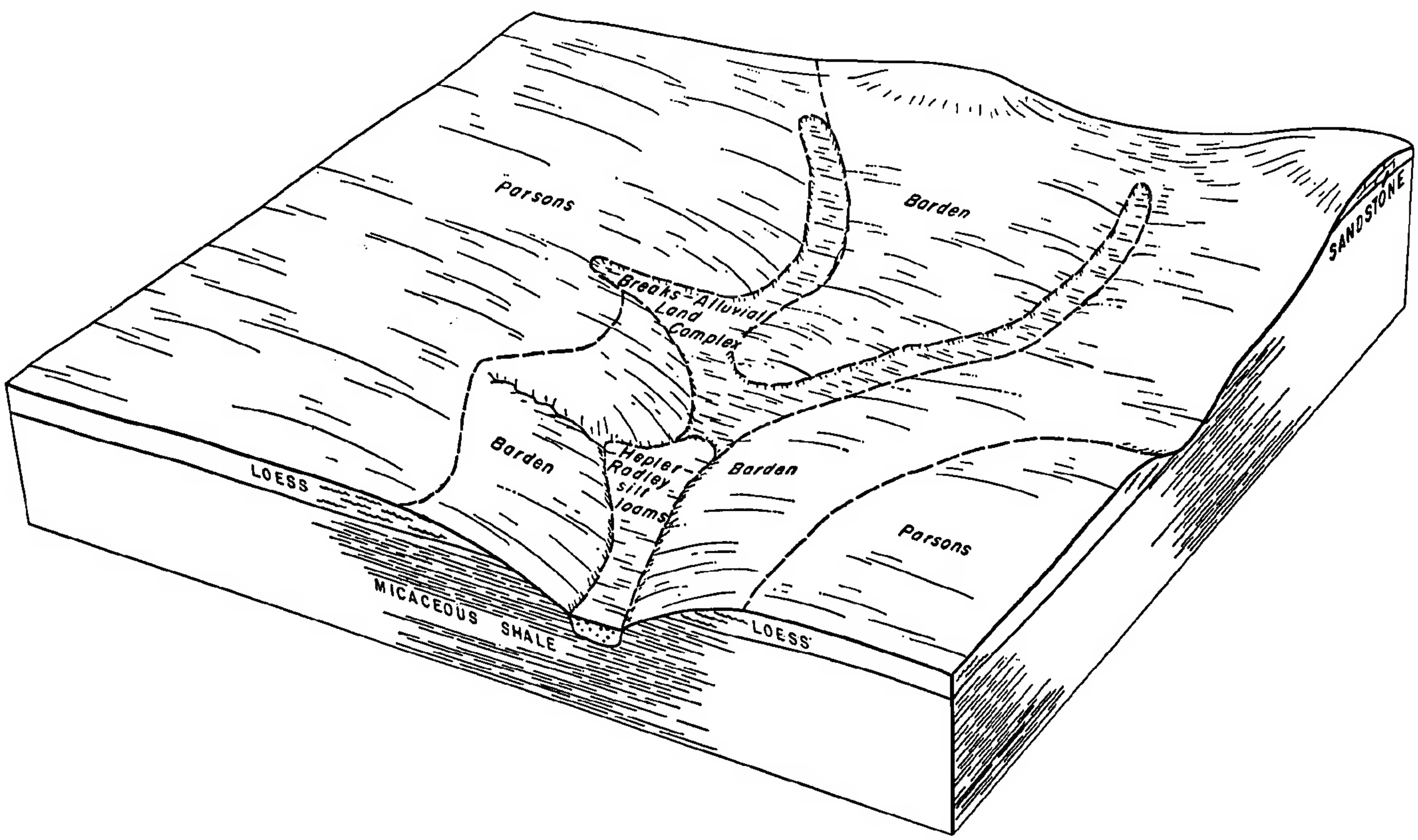

Figure 3.—**The major soils in the Parsons-Barden association, showing their general location on the landscape and the material in which they formed.**

sandstone. The moderately deep Liberal soils formed in material weathered from shale.

The soils in this association are farmed in large tracts, and big farm machinery is used. Most of the acreage is in intertilled row crops and small grain that are marketed as cash grain. Tame grass is grown for pasture, hay, and seed on much of the remaining acreage. Legumes, mostly lespedeza, are grown with this grass on some farms. A small, diminishing acreage is in prairie grass that is mowed for hay.

Erosion, seasonal droughtiness, and to a lesser degree, seasonal wetness are major limitations to the use of this association. Under highly specialized management, row crops can be grown year after year in nearly level areas. Parsons and Barden soils both have potential for irrigation.

3. *Barco-Collinsville association*

Shallow to moderately deep, well-drained, gently sloping to moderately steep soils of the uplands; formed under grass in sandstone residuum

This association borders most of the larger streams and many upland drainageways in the county, except Dry Wood Creek and its tributaries. The landscape is characterized by somewhat broken, gently sloping, rounded divides that have gently sloping to moderately steep sides and are adjacent to flood plains (fig. 4). The broad and narrow bottoms of the North Fork of the Spring River and its tributaries are examples of the kind and extent of bottom lands included in this association. Barco and Collinsville soils are well drained, and both formed mainly in sandstone residuum. The association occupies about 26 percent of the county.

Barco soils make up about 56 percent of the association; Collinsville soils, 19 percent; Hepler, Radley, Verdigris, and Cleora soils, 15 percent; and Parsons and Barden soils, the remaining 10 percent.

Barco soils are gently sloping, and in places the slopes are broken. These soils occupy rounded divides, side slopes, and foot slopes. The surface layer of Barco soils is very dark brown loam about 11 inches thick. The subsoil grades from dark-brownish, friable loam to mottled, brownish sandy clay loam. Depth to bedded sandstone is 20 to 40 inches.

Collinsville soils are gently sloping to moderately steep, and in many places the slopes are broken. Narrow ridgetops and points, side slopes, breaks, and knobs are all common landscape features. About one-fourth of the acreage of these soils is stony. Bedrock outcrops are common in some areas of both the nonstony and the stony Collinsville soils. The surface layer is dark-brown fine sandy loam about 10 inches thick. A thin, dark yellowish-brown subsoil is present in some places. Depth to bedded sandstone is less than 20 inches.

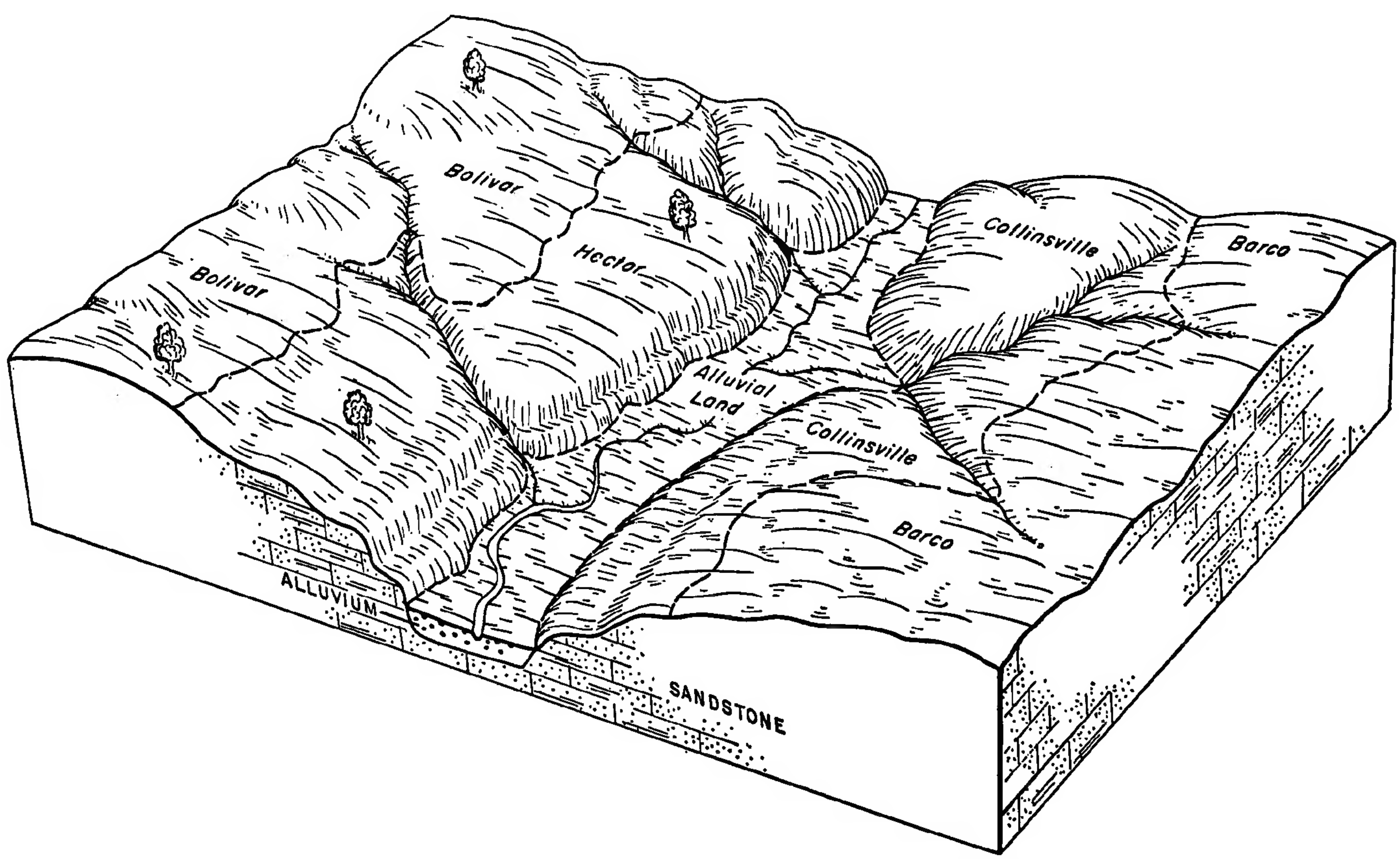

***Figure 4.*—The major soils in the Barco-Collinsville and the Hector-Bolivar associations, showing their general location on the landscape and the material in which they formed.**

Hepler, Radley, Verdigris, and Cleora soils are on bottom lands. The moderately well drained Radley and Verdigris soils and the well drained Cleora soils occupy narrow, low positions near stream channels. The somewhat poorly drained Hepler soils occupy the higher and wider flood plains.

Parsons and Barden soils are on uplands. These deep, nearly level or gently sloping soils occupy divides and benches.

About 65 percent of this association is used for pasture or hay. Stony areas of Collinsville soils are idle or are used for pasture. Wheat, grain sorghums, grasses, and legumes are grown on a large part of the acreage. Corn and soybeans also are grown. General livestock and grain farming are the main enterprises in this association.

Soils of the uplands and bottom lands are mostly low or medium in fertility. The bottom lands are subject to occasional or frequent overflow. Droughtiness and erosion in the uplands and wetness on the bottom lands are major limitations to the use of this association.

4. Hector-Bolivar association

Shallow to moderately deep, well-drained, gently sloping to steep soils of the uplands; formed under trees in sandstone residuum

This association consists of soils within the lower reaches of the watershed of Little Dry Wood Creek, Horse Creek, and the Little North Fork of the Spring River. These well-drained soils formed principally in sandstone residuum. Somewhat broken, gently sloping, rounded divides with gently sloping to steep sides that are adjacent to flood plains, characterize the landscape (see fig. 4). Bedrock escarpments at the upland edge of flood plains are common. The broad and narrow bottoms of Horse Creek and its tributaries are examples of the kind and extent of bottom lands included in this association. The association occupies about 7 percent of the county.

Hector soils make up about 50 percent of the association; Bolivar soils, 25 percent; Hepler, Cleora, Radley, and Verdigris soils, 20 percent; and Askew soils, most of the remaining 5 percent.

Hector soils are gently sloping to moderately steep. They occupy narrow rounded ridgetops and points, knobs, and side slopes. In places the slopes are broken. About one-half of these soils are stony. Bedrock outcrops are common in areas of both the stony and nonstony Hector soils. The surface layer is dark-brown fine sandy loam about 3 inches thick. The subsurface layer is brown fine sandy loam 6 inches thick. The subsoil is yellowish-brown gravelly fine sandy loam 4 inches thick. Depth to bedded sandstone is less than 20 inches.

Bolivar soils are gently sloping, and they occupy rounded ridgetops, side slopes, and foot slopes. In places the slopes are slightly broken. The surface layer is about 10 inches of dark-brown and brown fine sandy loam. The subsoil grades from brownish loam to mottled, reddish clay loam and is about 18 inches thick. Depth to bedded sandstone is 20 to 40 inches.

Hepler, Cleora, Radley, and Verdigris soils occupy bottom lands. The well drained Cleora soils and the moderately well drained Radley and Verdigris soils are in narrow, low positions near stream channels. Hepler soils are somewhat poorly drained and occupy the higher and somewhat wider flood plains.

Askew soils are deep, gently sloping soils that have a loamy surface layer and subsoil. They are on terraces, natural levees, and foot slopes.

More than 50 percent of this association is in pasture or hay, and about 35 percent is in trees or brush. Most of the remaining acreage is cultivated. Corn and soybeans are the major crops. In some places the soils are too steep or too stony for cultivated crops. General livestock and grain farming are the main enterprises.

Soils of uplands and bottom lands are mostly low or medium in fertility, and soils of the bottom lands are subject to occasional or frequent overflow. Droughtiness and erosion in the uplands and wetness on the bottom lands are the major limitations to the use of this association.

5. Mine pits and dumps association

Large trenchlike pits and irregularly shaped dumps consisting of a mixture of shale, sandstone, and soil stripped from coalbeds

This association consists of Mine pits and dumps that are in two large areas in a nearly continuous strip along the Kansas State line. The association occupies about 3 percent of the county.

Mine pits and dumps make up 82 percent of the association, and soils of the Parsons, Barden, Liberal, Collinsville, and Barco series make up most of the remaining 18 percent.

Mine pits and dumps appear to have been plowed with a gigantic plow; the dumps resemble furrow slices, and the elongated pits are like dead furrows. The steep, irregularly shaped dumps are a mixture of shale, sandstone, and the original mantle of soil that was stripped from the coalbeds. In some places large sandstone rocks litter the surface. Surface runoff is rapid. The plant cover is poor and provides little protection from erosion. Consequently, erosion continues at a very rapid rate. Low areas are ponded or seepy.

Each of the minor soils in the association is described in at least one other association in this soil survey.

In most places the dumps are scantily covered with brush, weeds, and undesirable grasses. Only a small part of their acreage is in native or improved tame grasses. Most of these areas are suitable for grazing, wildlife food and cover, and recreation, and they are used for these purposes. Susceptibility to erosion and a lack of easy access are major factors that limit the use of these areas.

Clearing brush, smoothing the dumps, and seeding them to adapted grasses, trees, and shrubs improve the suitability of the dumps for wildlife, recreation, grazing, and woodland and for growing Christmas trees.

6. Creldon-Carytown-Parsons association

Deep, poorly drained to moderately well drained, nearly level to sloping soils of the uplands; formed under grass in cherty limestone and shale residuum

This association consists of nearly level to sloping soils on divides and sides of divides that are adjacent to foot slopes and flood plains (fig. 5). Broad and narrow areas of soils on bottom land also are in the association.

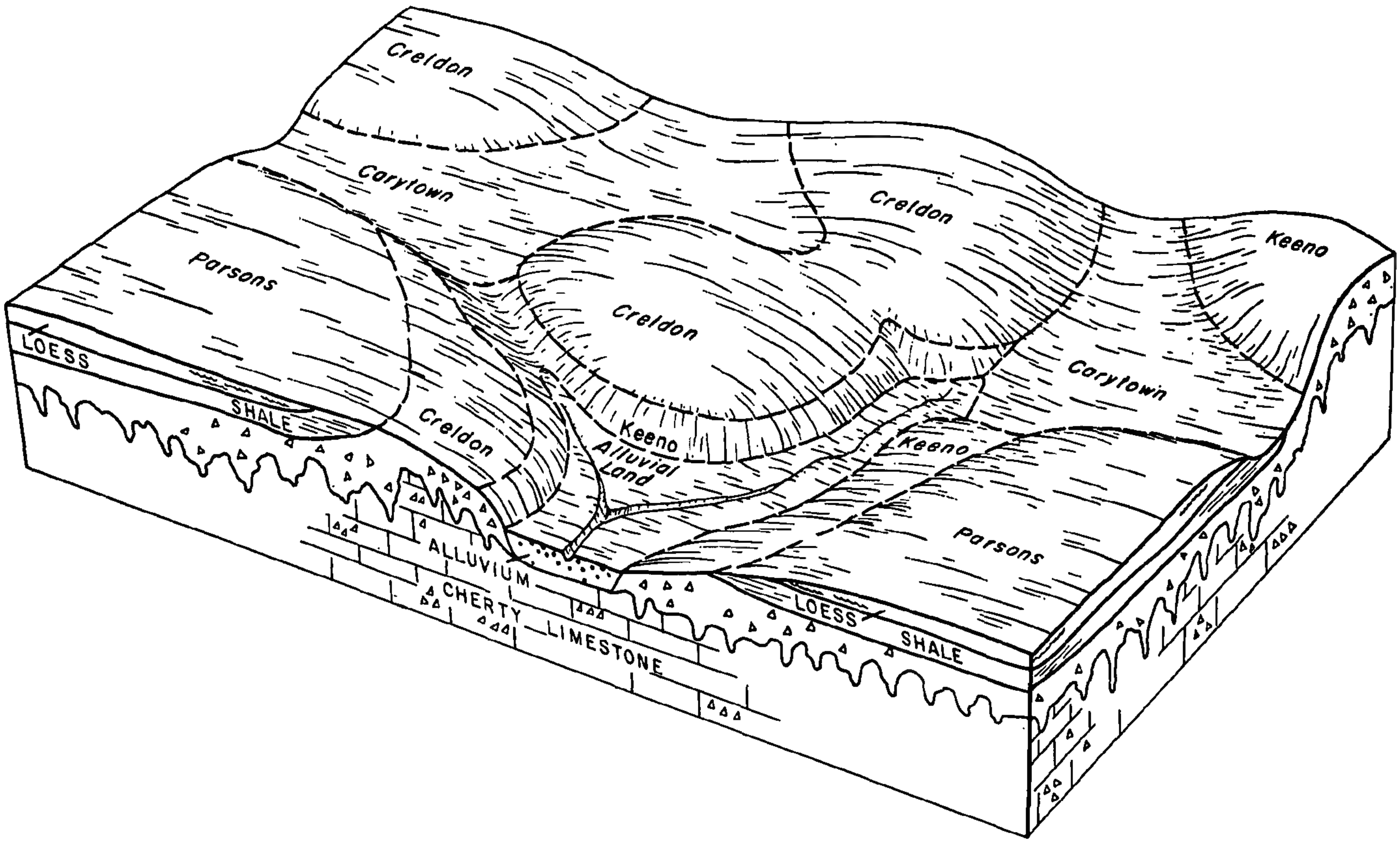

Figure 5.—**The major soils of the Creldon-Carytown-Parsons association, showing their general location on the landscape and the material in which they formed.**

The major soils formed in residuum that is thinly mantled in many places by loess or old silty alluvium. The association is in the southeast part of the county. It occupies about 6 percent of the county.

Creldon soils make up about 30 percent of the association; Carytown soils, 23 percent; Parsons soils, 15 percent; and minor soils, the remaining 32 percent.

Creldon soils are moderately well drained and gently sloping. The surface layer is very dark grayish-brown to dark-brown silt loam about 10 inches thick. The subsoil is mottled dark yellowish-brown and yellowish-brown silty clay loam about 10 inches thick. It is underlain by a very cherty silty clay loam fragipan about 25 inches thick.

Carytown soils are poorly drained and nearly level. These soils formed mostly in material weathered from shale that has a high sodium content. The surface layer is dark grayish-brown and dark-gray silt loam about 9 inches thick. The subsurface layer is grayish-brown silt loam that has an abrupt lower boundary. The clay subsoil grades from very dark grayish brown to light olive brown. In most places the upper part of the subsoil has prominent red mottles. The lower part of the subsoil and the underlying material are alkaline, but the surface layer and the upper part of the subsoil are acid in many places.

Parsons soils are somewhat poorly drained, nearly level or gently sloping soils on divides and benches. The surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is dark grayish-brown silt loam 6 inches thick that is platy and has an abrupt lower boundary. The upper part of the subsoil is very dark grayish-brown to dark yellowish-brown clay about 12 inches thick. It has many dark-red mottles. The lower part is brownish and grayish silty clay loam about 22 inches thick.

Moderately well drained, gently sloping to sloping Keeno soils make up about 13 percent of this association. Somewhat poorly drained, nearly level to gently sloping Summit soils and, to a lesser extent, well-drained, gently sloping Newtonia soils make up about 8 percent. They are on ridgetops, side slopes, and foot slopes. The remaining 11 percent of the association consists of Radley, Verdigris, Lanton, and Hepler soils on bottom lands. Moderately well drained Radley and Verdigris soils and poorly drained Lanton soils are in meander belts near stream channels. Other areas of Lanton soils and the somewhat poorly drained Hepler soils are on higher and wider flood plains.

About 60 percent of this association is in intertilled row crops and small grain that are marketed in part as cash-grain crops. Most of the remaining acreage is in pasture or hay. Stony Keeno soils are either idle or used for pasture. Seed is harvested from a small acreage of grasses and legumes.

Erosion, wetness, droughtiness, and stoniness are the major factors that limit the use of this association. Under highly specialized management, row crops can be grown year after year on the nearly level Parsons soils. Parsons and Carytown soils and the deep Creldon soils have a potential for irrigation.

7. *Nixa-Lebanon association*

Deep, moderately well drained, gently sloping and sloping soils of the uplands; formed under trees in cherty limestone residuum

The landscape in this association is characterized by gently sloping divides with gently sloping to sloping sides that are adjacent to foot slopes or flood plains, or both (fig. 6). The association is adjacent to and includes part of the valley of the North (Muddy) Fork of the Spring River in the southern part of the county. It occupies about 1 percent of the county.

Nixa soils make up about 39 percent of the association; Lebanon soils, 30 percent; and Radley, Verdigris, Lanton, and Hepler soils, the remaining 31 percent.

Nixa and Lebanon soils are moderately well drained. The gently sloping Lebanon soils formed in loess-mantled, cherty limestone residuum. The gently sloping and sloping Nixa soils formed in material weathered almost entirely from cherty limestone.

Nixa soils have a surface layer of dark-brown cherty to very cherty silt loam about 4 inches thick. The subsurface layer is brown very cherty silt loam about 9 inches thick, and the subsoil is brown very cherty heavy silt loam that is about 16 inches thick and is underlain by a mottled very cherty silt loam fragipan about 23 inches thick.

Lebanon soils have a surface layer of very dark grayish-brown silt loam about 2 inches thick. The subsurface layer is grayish-brown and brown silt loam about 4 inches thick. The upper part of the subsoil is brownish silty clay loam that is about 16 inches thick and is underlain by a mottled grayish, brownish, and reddish very cherty silty clay loam fragipan about 16 inches thick.

Radley, Verdigris, Lanton, and Hepler soils are on bottom lands. The moderately well drained Radley, and Verdigris soils and the poorly drained Lanton soils are in low positions near stream channels. The somewhat poorly drained Hepler soils and a small part of the Lanton soils are on higher, somewhat wider flood plains.

About 40 percent of this association is in pasture, and about 30 percent is in trees or brush. Wheat, sorghums, grasses, and legumes are grown on most of the remaining acreage, and corn and soybeans are important crops on the bottom lands. Grain farming and raising livestock are the main enterprises.

The high content of chert in soils of the uplands makes cultivation difficult in some places. Most of the soils on uplands and bottom lands are low or medium in fertility, and the bottom lands are subject to occasional or frequent overflow. Erosion and droughtiness in the uplands and wetness on the bottom lands are the major limitations to the use of this association.

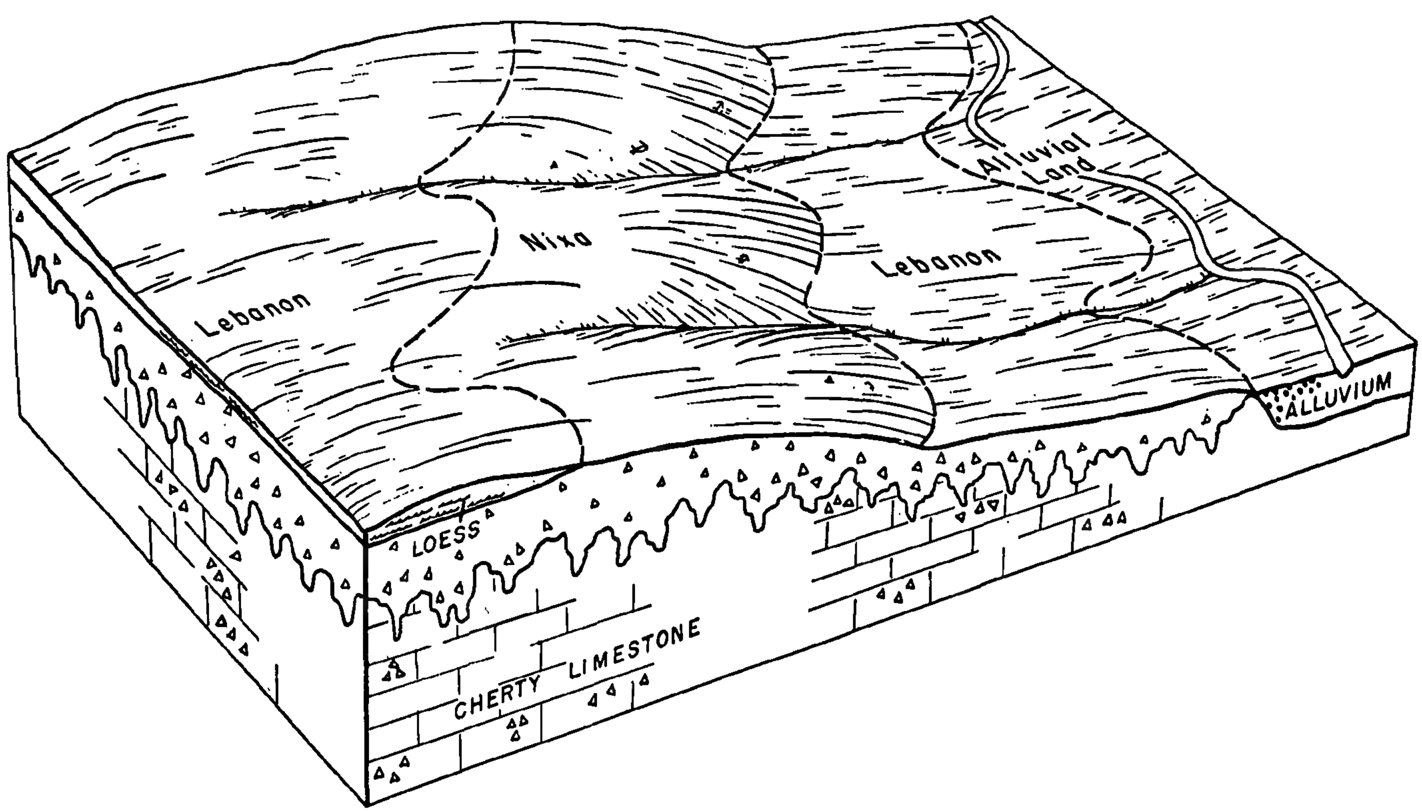

Figure 6.—The major soils in the Nixa-Lebanon association, showing their general location on the landscape and the material in which they formed.

Descriptions of the Soils

This section describes the soil series and mapping units of Barton County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Mine pits and dumps, for example, is a miscellaneous land type that does not belong to a soil series. It is listed, nevertheless, in alphabetical order along with the soil series.

In comparing a mapping unit with a soil series, many will prefer to read the short description in paragraph form. It precedes the technical description that identifies layers by A, B, and C horizons and depth ranges. The technical profile descriptions are mainly for soil scientists and others who want detailed information about soils. Unless otherwise indicated, the colors and consistence given in the descriptions are those of a moist soil. Some of the terms used to describe the soils are defined in the Glossary at the back of this soil survey.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed.

Askew Series

The Askew series consists of deep, gently sloping soils on stream terraces, natural levees, and foot slopes near the major streams. These soils formed under tall grasses and mixed hardwood trees in material deposited by streams or moved downslope from higher upland positions. A loess mantle is present in some places.

In a representative profile, the surface layer is medium acid, dark grayish-brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is very strongly acid, friable to firm silty clay loam about 54 inches thick. It is yellowish brown in the upper part, light yellowish brown in the middle part, and strong brown in the lower part. It has grayish mottles. The underlying material is strong-brown, friable, strongly acid silty clay loam.

Askew soils are low in natural fertility and are moderately well drained. Runoff is medium, permeability is moderate, and the available water capacity is high. Susceptibility to erosion is the major limitation that affects the use of these soils.

Most areas of these soils are used to grow sorghum, small grain, corn, soybeans, and hay or are in pasture. Wheat and sorghums are the most important crops. A small acreage is in timber.

Representative profile of Askew silt loam, 2 to 5 percent slopes, in an area of grass, 220 feet south and 295

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Askew fine sandy loam, 2 to 5 percent slopes	550	0.1
Askew silt loam, 2 to 5 percent slopes	1,550	.4
Askew silt loam, 2 to 5 percent slopes, eroded	341	.1
Barco fine sandy loam, 2 to 5 percent slopes	7,800	2.1
Barco fine sandy loam, 2 to 5 percent slopes, eroded	2,300	.6
Barco loam, 2 to 5 percent slopes	31,500	8.3
Barco loam, 2 to 5 percent slopes, eroded	7,300	1.9
Barden silt loam, 1 to 4 percent slopes	60,500	15.9
Barden silt loam, 1 to 4 percent slopes, eroded	8,400	2.2
Bolivar fine sandy loam, 2 to 5 percent slopes	4,600	1.2
Bolivar fine sandy loam, 2 to 5 percent slopes, eroded	1,250	.3
Breaks-Alluvial land complex	17,400	4.6
Bronaugh silt loam, 2 to 5 percent slopes	900	.2
Carytown silt loam	5,900	1.5
Cherokee silt loam	5,200	1.4
Cleora fine sandy loam	1,200	.3
Collinsville fine sandy loam, 2 to 5 percent slopes	6,400	1.7
Collinsville fine sandy loam, 5 to 14 percent slopes	6,100	1.6
Collinsville stony fine sandy loam, 2 to 14 percent slopes	4,300	1.1
Creldon silt loam, 1 to 4 percent slopes	3,000	.8
Creldon silt loam, 1 to 4 percent slopes, eroded	378	.1
Creldon silt loam, deep, 1 to 4 percent slopes	4,300	1.1
Hector fine sandy loam, 2 to 5 percent slopes	3,450	.9
Hector fine sandy loam, 5 to 14 percent slopes	2,600	.7
Hector stony fine sandy loam, 2 to 14 percent slopes	3,350	.9
Hector stony fine sandy loam, 14 to 30 percent slopes	2,050	0.5
Hepler silt loam	11,400	3.0
Hepler silt loam, overwash	2,350	.6
Hepler-Radley silt loams	9,600	2.5
Keeno cherty silt loam, 2 to 9 percent slopes	2,100	.5
Keeno stony silt loam, 2 to 9 percent slopes	1,400	.4
Lanton silty clay loam	251	.1
Lanton and Verdigris silt loams	1,100	.3
Lebanon silt loam, 2 to 5 percent slopes	1,050	.3
Liberal silt loam, 2 to 6 percent slopes	3,300	.9
Liberal silty clay loam, 2 to 9 percent slopes, eroded	3,700	1.0
Liberal, Collinsville and Barco soils, 2 to 14 percent slopes	6,700	1.8
Mine pits and dumps	12,000	3.2
Newtonia silt loam, 1 to 3 percent slopes	590	.1
Nixa cherty silt loam, 2 to 9 percent slopes	1,400	.4
Parsons silt loam, 0 to 1 percent slopes	93,500	24.5
Parsons silt loam, 1 to 3 percent slopes	19,300	5.1
Parsons silt loam, 1 to 3 percent slopes, eroded	4,050	1.1
Radley and Verdigris silt loams	8,200	2.2
Summit silty clay loam, 0 to 2 percent slopes	1,150	.3
Summit silty clay loam, 2 to 5 percent slopes	1,350	.4
Water (creeks, large mine pits, ponds, and reservoirs)	3,050	.8
Total	380,160	100.0

feet east of the northwest corner of sec. 20, T. 31 N., R. 30 W.:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few, fine, faint, dark yellowish-brown root stains; weak, very fine, platy structure; very friable; common roots; common worm channels and casts; few iron and manganese concretions; medium acid; abrupt, smooth boundary.

A2—5 to 10 inches, brown (10YR 5/3) silt loam; common, fine, faint, grayish-brown (10YR 5/2) mottles and few, fine, faint, dark grayish-brown mottles; weak, thin, platy structure; very friable; few roots; vesicular; common worm channels and casts; few iron and manganese concretions; strongly acid; clear, smooth boundary.

B1t—10 to 14 inches, yellowish-brown (10YR 5/4) light silty clay loam; common, fine, faint, dark grayish-brown (10YR 4/2) mottles and very dark grayish-brown (10YR 3/2) mottles; moderate, very fine, subangular blocky structure; friable; few roots; thin patchy clay films; vesicular; many worm channels and casts; some casts are very dark grayish brown; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

B21t—14 to 18 inches, yellowish-brown (10YR 5/4) silty clay loam; few, fine, faint, dark grayish-brown and yellowish-brown mottles; moderate, fine and very fine, subangular blocky structure; firm; few roots; thin patchy clay films; common worm channels and casts; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

B22t—18 to 26 inches, light yellowish-brown (10YR 6/4) silty clay loam; common, fine, distinct, yellowish-red (5YR 5/8) mottles; weak, fine and very fine, subangular blocky structure; firm; few roots; thin patchy clay films; few worm channels; many iron and manganese concretions; very strongly acid; clear, smooth boundary.

B23t—26 to 36 inches, coarsely mottled strong-brown (7.5YR 5/6), yellowish-brown (10YR 5/6) and light brownish-gray (10YR 6/2) heavy silty clay loam; common, fine, faint, light-gray, very dark grayish-brown, and yellowish-red mottles; weak, coarse, subangular blocky structure; firm; few roots; thick, dark grayish-brown clay films line most cracks and worm and root channels; common iron and manganese concretions; very strongly acid; clear, smooth boundary.

B3t—36 to 64 inches, coarsely mottled strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) silty clay loam; weak, coarse, subangular blocky structure; firm; gray clay films line many pores; few worm channels; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

C—64 to 72 inches, strong-brown (7.5YR 5/6) silty clay loam; few, fine, distinct, light brownish-gray (10YR 6/2) mottles and common, medium, faint dark yellowish-brown mottles; massive; friable; few iron and manganese concretions; strongly acid.

The Ap horizon, or the A1 horizon, ranges from silt loam to fine sandy loam. Where an A1 horizon is present, it is very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) and is about 1 to 4 inches in thickness. The Ap horizon and the A2 horizon range from brown (10YR 4/3) to grayish-brown (10YR 5/2) and are about 4 to 10 inches total in thickness. The Bt horizon is 30 to 60 inches in thickness. The upper part is yellowish brown (10YR 5/4) in most places but ranges to brown (10YR 4/3). It has brownish to grayish mottles. Texture is loam, silt loam, and silty clay loam. The lower part ranges from strong brown (7.5YR 5/6) to light brownish gray (10YR 6/2) and has coarse, distinct mottles. These soils are medium acid to very strongly acid.

Askew soils are on stream terraces and foot slopes near Hepler, Carytown, Cherokee, Lebanon, and Bolivar soils. They are at higher elevations and have a lighter colored or thinner surface layer than Hepler soils. Askew soils have more silt and sand and less clay in the subsoil than Carytown, Cherokee, and Lebanon soils. They are deeper than Bolivar soils. Askew soils do not have a fragipan, as do the Lebanon soils.

Askew fine sandy loam, 2 to 5 percent slopes (AkB).—This soil is on stream terraces, natural levees, and foot slopes. Areas range from less than 5 acres to 20 acres in size. This soil has a profile similar to the one described as representative for the series, but it has more sand throughout the profile and the subsoil and underlying material have less clay and silt. The surface layer is brown fine sandy loam.

Included with this soil in mapping are a few small areas of Bolivar fine sandy loam, 2 to 5 percent slopes, and Askew silt loam, 2 to 5 percent slopes. Also included are small, scattered areas of eroded Askew soils. Most areas of these eroded soils have a fine sandy loam surface layer.

A good response to management can be expected. Because this soil is susceptible to erosion, the choice of crops is reduced and special conservation practices are required. The soil is better suited to small grain, sorghum, and grass and legume crops than to most other crops. Capability unit IIIe-4.

Askew silt loam, 2 to 5 percent slopes (AsB).—This soil is on stream terraces, natural levees, and foot slopes. Areas range from less than 5 acres to more than 40 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are some small areas of Cherokee silt loam, Barden silt loam, 1 to 4 percent slopes, and Askew fine sandy loam, 2 to 5 percent slopes. The Cherokee and Barden soils are on the crests, and the Askew soil is on the side slopes.

A good response to management can be expected. Because this soil is susceptible to erosion, the choice of crops is reduced and special conservation practices are required. The soil is suited to small grain, sorghums, grasses, legumes, and to a lesser degree, corn and soybeans. Capability unit IIe-1.

Askew silt loam, 2 to 5 percent slopes, eroded (AsB2).—This soil is near the slope break on stream terraces. Areas range from less than 5 acres to about 20 acres in size. This soil has a profile similar to the one described as representative for the series, but the surface layer is brown and is only 4 to 6 inches thick. A few gullies and erosion scars expose the brighter colored, more clayey subsoil in many places.

Included with this soil in mapping are a few small areas of Askew fine sandy loam, 2 to 5 percent slopes. Also included are small areas of uneroded and severely eroded Askew soils.

A good response to management can be expected. Because this soil is susceptible to further erosion, its use is limited and the choice of plants is reduced or special conservation practices are required. The soil is suited to small grain, sorghum, grass and legume crops and, to a lesser degree, corn and soybeans. Capability unit IIIe-4.

Barco Series

The Barco series consists of moderately deep, gently sloping soils on uplands. These soils are underlain by sandstone at a depth of 20 to 40 inches, and sandstone fragments are on the surface and throughout the soil

(figs. 7 and 8). In many places the sandstone is interbedded with thin layers of shale. Barco soils formed under tall prairie grass in sandstone residuum. They are on upland divides and mounds in all parts of the county but the southeastern corner.

In a representative profile, the surface layer is strongly acid, very dark brown loam about 11 inches thick. The subsoil is friable, very strongly acid to strongly acid, and about 23 inches thick. It is dark-brown and dark yellowish-brown loam in the upper part to brown and yellowish-brown sandy clay loam in the lower part. The subsoil contains reddish mottles. The underlying material is weathered, soft, very strongly acid, red and light yellowish-brown sandstone that contains thin lenses of shale.

Barco soils are medium in natural fertility and are well drained. Runoff is medium, permeability is moderate, and the available water capacity is moderate to low. Moderate depth to sandstone in many places makes these soils somewhat droughty, but susceptibility to erosion is the major limitation that affects their use.

More than half the acreage of these soils is cultivated.

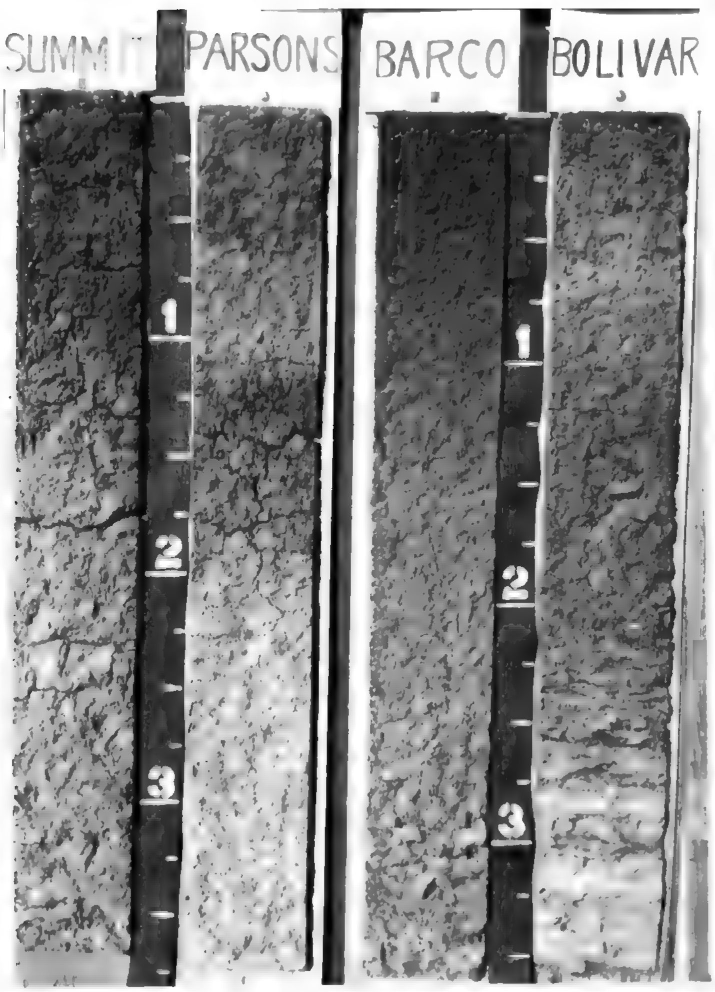

***Figure 7.*—Monoliths representative of the Summit, Parsons, Barco, and Bolivar soils in Barton County. The Barco and Bolivar monoliths are from profiles that are representative for their respective series.**

***Figure 8.*—Profile of Barco fine sandy loam, 2 to 5 percent slopes.**

Most of the rest is in grasses and legumes that are used for hay and pasture. The principal cultivated crops are small grain, corn, sorghums, and soybeans.

Representative profile of Barco loam, 2 to 5 percent slopes, in a native prairie meadow, 322 feet north and 1,320 feet west of the southeast corner of sec. 26, T. 32 N., R. 31 W.:

A1—0 to 11 inches, very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; strong and moderate, very fine and fine, granular structure; very friable; many roots; many worm channels and casts; few fragments of sandstone; strongly acid; gradual, smooth boundary.

B1—11 to 18 inches, dark-brown (10YR 3/3) loam; weak, very fine, subangular blocky structure; friable; common roots; common very dark grayish-brown ped coats and worm casts; few fragments of sandstone; very strongly acid; gradual, smooth boundary.

B21t—18 to 23 inches, dark yellowish-brown (10YR 4/4) heavy loam; common, fine, distinct, yellowish-red (5YR 4/6) mottles; weak, very fine and fine, subangular blocky structure; friable; few roots; thin patchy clay films; common very dark grayish-brown ped coats and worm casts; few fragments of sandstone; very strongly acid; gradual, smooth boundary.

B22t—23 to 30 inches, brown (7.5YR 5/4) sandy clay loam; few, coarse, faint, red (2.5YR 4/8) mottles and few, fine, faint, dark-brown (7.5YR 4/4) mottles; weak, very fine and fine, subangular blocky structure; friable; few roots; thin patchy clay films; common, very dark grayish-brown ped coats and worm casts; few fragments of sandstone; very strongly acid; gradual, smooth boundary.

B3t—30 to 34 inches, yellowish-brown (10YR 5/4) sandy clay loam; many, medium, prominent, red (2.5YR 4/8) mottles and common, medium, faint, brown mottles; weak, fine and medium, subangular blocky structure; friable; thin, gray, patchy clay films; few iron concretions; common, soft fragments of sandstone; strongly acid; gradual, wavy boundary.

C—34 to 48 inches, red and light yellowish-brown, soft, weakly stratified sandstone; thin discontinuous lenses of shale; very strongly acid.

The A1 horizon is 7 to 15 inches thick in uneroded areas and ranges from very dark brown (10YR 2/2) to dark brown (10YR 3/3) in color. It is about 6 inches thick in eroded areas and is dominantly dark brown. Texture is loam or fine sandy loam. The B horizon ranges from 8 to 30 inches in thickness and is medium acid or strongly acid. The B1 horizon ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/6) and from fine sandy loam to clay loam. The B2t horizon ranges from dark yellowish brown (10YR 4/4) to strong brown (7.5YR 5/6) and is loam, clay loam, and sandy clay loam. In many places the B3t horizon is absent where the depth to sandstone is less than 30 inches. Thick, grayish clay films or flows are absent in the B3t horizon in some places.

Barco soils are associated with Bolivar, Hector, Collinsville, Parsons, Liberal, Barden, and Bronaugh soils. They have a darker colored or thicker surface layer than Bolivar and Hector soils. Barco soils are deeper than Hector and Collinsville soils. They have more sand and less clay throughout their depth than Parsons, Liberal, Barden, and Bronaugh soils. Barco soils are not so deep as Parsons, Barden, or Bronaugh soils.

Barco fine sandy loam, 2 to 5 percent slopes (BaB).—This soil is on rounded ridgetops, points, side slopes, and foot slopes. Areas are of suitable shape for farming and are about 10 acres to more than 80 acres in size. This soil has a profile similar to the one described as representative for the series, except that the surface layer is dark-brown fine sandy loam and the somewhat thinner subsoil contains less clay and more sand and coarse fragments.

Included with this soil in mapping are areas of Bolivar fine sandy loam, 2 to 5 percent slopes, in the transitional belt between prairie and woodland. These inclusions make up as much as 10 percent of the mapped areas. Also included are areas of Barco loam, 2 to 5 percent slopes, and areas of Barden and Collinsville soils. The Barco loam makes up as much as 10 percent of the acreage mapped, and the Barden and Collinsville soils each make up 5 percent. The Barco and Barden soils are below breaks or near the heads of draws on low slopes. The Collinsville soil is on the breaks of side slopes. Other inclusions are spots of eroded soils and a few small areas of soils that have slopes of more than 5 percent.

This Barco soil has a low available water capacity. A good response to management can be expected. This soil is susceptible to erosion and drought, and these limitations reduce the choice of crops or special conservation practices are required. The soil is better suited to small grain, grasses, and legumes than to most other crops. The soil also is suited to sorghums, corn, and soybeans and has a potential for growing alfalfa. It is well suited to berries and peach trees. Capability unit IIIe-4.

Barco fine sandy loam, 2 to 5 percent slopes, eroded (BaB2).—This soil is near the slope break on ridgetops, points, side slopes, and foot slopes. In most places the areas are widely separated or are dissected by drainageways. They are about 5 acres to more than 80 acres in size. This soil has a profile similar to the one described as representative for the series, except that it has more sand and less clay throughout the profile and the surface layer has been altered by erosion. The surface layer is about 6 inches of dark-brown fine sandy loam. Erosion scars and gullies expose the somewhat thinner, brighter colored, finer textured subsoil in many places.

Included with this soil in mapping are areas of Barco fine sandy loam, 2 to 5 percent slopes, and areas of Collinsville soils. The included Barco soil makes up 10 percent of the acreage mapped, and the Collinsville soils 5 percent. The Barco soil is on the crests of ridges and near drainageways, and the Collinsville soils are on the breaks of side slopes. Also included are small, scattered areas of Barco loam, 2 to 5 percent slopes, and Barden silt loam, 1 to 4 percent slopes, at the heads of drainageways. Other inclusions are spots of severely eroded soils and small areas of soils that have slopes of more than 5 percent.

This Barco soil is low in available water capacity. A fair response to management can be expected. Because this soil is very susceptible to further erosion and drought, the choice of plants is restricted and very careful management is required. This soil is better suited to grass and legumes than to most other crops. Small grain and an occasional sorghum crop can be safely grown with hay or pasture crops in long rotations. Capability unit IVe-7.

Barco loam, 2 to 5 percent slopes (BcB).—This soil is in convex areas on knobs, rounded ridgetops, points, side slopes, and foot slopes. The areas are of suitable shape for farming and are about 5 acres to more than 80 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Liberal, Collinsville, and Barden soils. The Liberal soil makes up about 10 percent of the acreage mapped, the Collinsville soil 5 percent, and the Barden soil 15 percent. The Liberal soil is on knobs, the Collinsville soil is on knobs and breaks of side slopes, and the Barden soil is below breaks or in saddles that cross narrow ridgetops. Also included are a few spots of eroded soils and small areas of soils that have slopes of more than 5 percent.

This Barco soil has moderate available water capacity. A very good response to management can be expected. Because the soil is susceptible to erosion and drought, the choice of crops is reduced and moderate conservation practices are required. The soil is suited to corn, sorghums, small grain, soybeans, grasses, and alfalfa and other legumes. It is well suited to berries and peach trees. It has potential for growing corn and vegetable crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIe-4.

Barco loam, 2 to 5 percent slopes, eroded (BcB2).—This soil is near the slope break on knobs, ridgetops, points, side slopes, and foot slopes. Most areas are small and widely separated or are relatively large and dissected by gullies and drainageways. They range from less than 5 acres to more than 80 acres in size. This soil has a profile similar to the one described as representative for the series, except that the surface layer has been altered by erosion. The present surface layer is about 6 inches of very dark grayish-brown loam and is a mixture of the remaining original surface layer and some subsoil material. Erosion scars and gullies expose the brighter colored, somewhat finer textured subsoil in many places.

Included with this soil in mapping are areas of uneroded Barco soils on the crests of ridgetops and along drainageways and small areas or spots of severely eroded soils near the slope break at the heads of drainageways. Together, these included soils make up 15 percent of many mapped areas. Also included are areas of Collinsville and Barden soils. Each of these included soils makes up 5 percent of the mapped areas. The Collinsville soils are on the breaks of side slopes, and the Barden soils are on foot slopes or in saddles that cross narrow ridgetops.

This Barco soil has low available water capacity. A good response to management can be expected. Because the soil is susceptible to further erosion and to drought, the choice of crops is reduced or special conservation practices are required. The soil is better suited to small grain, grasses, and legumes than to most other crops. Sorghum, corn, or soybeans, can be safely grown in rotations that include hay or pasture crops. Capability unit IIIe-4.

Barden Series

The Barden series consists of deep, nearly level and gently sloping soils on upland divides and benches in all parts of the county but the southeastern corner. These soils formed under tall prairie grasses in shale residuum. In most places a thin mantle of loess or silty alluvium is over the residuum.

In a representative profile, the surface layer is very dark grayish brown, strongly acid silt loam about 11 inches thick. The subsoil is strongly acid to medium acid, is about 45 inches thick, and contains highly contrasting mottles. The upper part of the subsoil is dark-brown, friable silty clay loam and yellowish-brown, firm silty clay. The lower part is brownish and grayish, firm silty clay loam. The underlying material is mottled, yellowish-brown, massive, friable silty clay loam.

Barden soils are medium in natural fertility and are moderately well drained. Runoff is medium, permeability is slow, and the available water capacity is high. Susceptibility to erosion is the major limitation that affects the use of these soils.

More than half the acreage of these soils is in row crops and small grain. The important crops are corn, small grain, soybeans, and sorghums. Most of the remaining acreage is in tame grasses, legumes, and native tall prairie grasses that are used for pasture or hay.

Representative profile of Barden silt loam, 1 to 4 percent slopes, in a native prairie meadow, 2,275 feet west and 520 feet north of the southeast corner of sec. 6, T. 31 N., R. 32 W.:

A1—0 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; strong, very fine and fine, granular structure; very friable; many roots: common worm channels and casts; few iron and manganese concretions; strongly acid; gradual, smooth boundary.

B1t—11 to 18 inches, dark-brown (10YR 4/3 and 7.5YR 4/4) silty clay loam; few, fine, faint, dark grayish-brown mottles and very dark grayish-brown mottles; moderate, very fine, subangular blocky structure; friable; common roots; thin patchy clay films; many worm channels; many dark grayish-brown and very dark grayish-brown worm casts; few iron and manganese concretions; very strongly acid; gradual, smooth boundary.

B21t—18 to 23 inches, yellowish-brown (10YR 5/4) silty clay; many, fine, prominent, red (2.5YR 4/8) mottles and few, fine, faint, brown mottles; moderate, very fine, subangular and angular blocky structure; firm; few roots; thin clay films; few worm channels; common iron and manganese concretions; very strongly acid; gradual, smooth boundary.

B22t—23 to 30 inches, mottled, yellowish-brown (10YR 5/8), dark grayish-brown (10YR 4/2), and red (2.5YR 4/8) silty clay; moderate, fine and very fine, subangular blocky structure; firm; few roots; dark-gray, gray, and very dark grayish-brown, continuous clay films, thick in most vertical cracks and many horizontal cracks; few worm channels; common iron and manganese concretions; strongly acid; gradual, smooth boundary.

B3t—30 to 56 inches, brown (7.5YR 5/6 and 5/8; 10YR 5/6, 5/8, 5/2, and 6/3) silty clay loam coarsely mottled with gray (10YR 5/1 and 6/2); weak, fine and very fine, subangular blocky structure; firm; thin patchy clay films; common iron and manganese concretions; large black splotches of concretionary material concentrated in the lower 15 inches; medium acid; gradual, smooth boundary.

C—56 to 72 inches, yellowish-brown (10YR 5/8) silty clay loam; few, fine, distinct, pale-brown (10YR 6/3) and light-gray (10YR 7/2) mottles; massive; friable; many iron and manganese concretions; large black splotches of concretionary material; strongly acid.

The A1 horizon, or the Ap horizon, is 9 to 15 inches thick in uneroded areas. It is about 6 inches thick in eroded areas. Texture is dominantly silt loam, but in some places it is fine sandy loam or silty clay loam. The B1t horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4) in color and is slightly acid to very strongly acid. Texture is silty clay loam or clay loam. The B2t horizon is light silty clay, heavy silty clay loam, or heavy clay loam and is from 10 to 20 inches thick. It is dominantly yellowish brown (10YR 5/4 to 5/8) but ranges to grayish brown (10YR 5/2). Mottles range from dark gray (10YR 4/1) to yellowish red (2.5YR 4/8). In most places thick continuous clay films that range from black (10YR 2/1) to dark grayish brown (10YR 4/2) are present in the lower part. Combined thickness of the Bt horizons is 37 to 55 inches. The B3 and C horizons are yellowish brown (10YR 5/6 or 5/8) or strong brown (7.5YR 5/6 or 5/8) and coarsely mottled with grayish colors. Grayish colors are dominant in some places. Texture of the B3 and C horizons is silty clay, silty clay loam, or clay loam. Except where the surface layer has been limed, these soils range from very strongly acid to medium acid.

In most places the Barden soils are near Barco and Parsons soils. In some places they are near Collinsville, Bronaugh, Summit, and Liberal soils. Barden soils have more clay and less sand in the upper 20 inches of the subsoil than the Barco soils. They have a gradual change in texture from the surface layer to the subsoil, but the change is abrupt in the Parsons soils. Barden soils are deeper than Liberal, Barco, and Collinsville soils. They have a lower content of clay throughout than the Liberal soils. Barden soils have a lower content of clay in the surface layer than Summit soils, and the very dark colors do not extend so deep into the subsoil as they do in those soils. They are less red throughout the profile than Bronaugh soils.

Barden silt loam, 1 to 4 percent slopes (BdB).—This soil is in convex areas on knobs, ridgetops, points, side slopes, and benches (see cover picture). Areas are about 7 acres to more than 100 acres in size and are smooth and well shaped for farming. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Parsons, Barco, and Liberal soils. The Parsons soils make up as much as 20 percent of the acreage mapped; the Barco soils, 10 percent; and the Liberal soils, 10 percent. The Parsons soils are on the crests of ridgetops and foot slopes near drainageways. The Barco and Liberal soils are on

small knobs and steeper, somewhat broken side slopes. Wet bands of seepage on foot slopes near Collinsville soils and small areas of eroded Barden soils near the heads of draws also are included. These inclusions together generally make up no more than 20 percent of any mapped area.

A very good response to management can be expected. This soil is susceptible to erosion, and this limitation reduces the choice of crops or imposes a need for moderate conservation practices. The soil is suited to corn, sorghums, soybeans, small grain, grass, and legume crops. The better drained areas are favored for alfalfa. This soil has a good potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIe-2.

Barden silt loam, 1 to 4 percent slopes, eroded (BdB2).—This soil is in slightly concave areas near the slope break of knobs, ridgetops, points, side slopes, and benches. Compared to other Barden soils, this soil has slopes that are longer or steeper, or both. In most places the areas are small and widely separated or are large and dissected by gullies and drainageways. They range from about 5 acres to more than 40 acres in size. This soil has a profile that is similar to the one described as representative for the series, but the surface layer is about 6 inches of very dark grayish-brown or dark-brown silt loam. Erosion scars and a few small gullies expose the brighter colored, finer textured subsoil in some places.

Included with this soil in mapping are areas of Parsons silt loam, 1 to 3 percent slopes, and areas of Barco and Liberal soils. The Parsons soil makes up as much as 20 percent of the acreage mapped; the Barco soil, 5 percent; and the Liberal soil, 5 percent. The Parsons soil is near drainageways. The Barco and Liberal soils are on knobs or steeper, somewhat broken side slopes. In some mapped areas where slopes are about 1 percent, areas of Barden silt loam, 1 to 4 percent slopes, make up as much as 20 percent of the area. These inclusions together rarely make up more than 25 percent of any mapped area.

Response to management is good. Susceptibility to further erosion and slight drought severely limit the use of this soil. These limitations reduce the choice of crops or impose a need for special conservation practices. The soil is suited to sorghums, small grain, grasses, legumes, corn, and soybeans. Capability unit IIIe-5.

Bolivar Series

The Bolivar series consists of gently sloping soils that are underlain by sandstone at a depth of 20 to 40 inches (fig. 9). Sandstone fragments are on the surface and throughout the profile. These soils are on low upland divides, mostly near Horse and Little Drywood Creeks and the Little North Fork of the Spring River. They formed under trees in sandstone residuum. In many places the sandstone is interbedded with thin layers of shale.

In a representative profile, the surface layer is strongly acid, dark-brown fine sandy loam about 8 inches thick. The subsurface layer is medium acid brown fine sandy loam about 2 inches thick. The subsoil is about 18 inches thick. It is strong-brown loam and yellowish-red clay loam in the upper part and is mottled, reddish and

Figure 9.—**Profile of Bolivar fine sandy loam, 2 to 5 percent slopes.**

brownish very gravelly sandy clay loam in the lower part. It is medium acid to very strongly acid. The underlying material is soft, very strongly acid, brown sandstone that has thin, dark-gray and light-gray lenses of shale and a few clay flows. This material grades to hard, red sandstone.

Bolivar soils are low in natural fertility and are well drained. Runoff is medium, permeability is moderate, and the available water capacity is low. Moderate depth to sandstone makes the soils somewhat droughty, but susceptibility to erosion is the major limitation.

About half the acreage of these soils is in grasses and legumes that are used for hay and pasture. The remaining acreage is in oak timber and cultivated crops of small grain, sorghum, corn, and soybeans.

Representative profile of Bolivar fine sandy loam, 2 to 5 percent slopes, in a pasture, 310 feet east and 2,510 feet south of the northwest corner of sec. 26, T. 33 N., R. 29 W.:

Ap—0 to 8 inches, dark-brown (10YR 4/3) fine sandy loam; weak, very fine, granular structure; very friable; many roots; many worm casts; strongly acid; abrupt, smooth boundary.

A2—8 to 10 inches, brown (10YR 5/3) fine sandy loam; weak, very fine, granular structure; very friable; many roots; many worm casts; medium acid; clear, smooth boundary.

B1—10 to 13 inches, strong-brown (7.5YR 5/6) loam; weak, fine, subangular blocky structure; friable; common roots; common casts, mostly grayish brown and dark

yellowish brown; medium acid; clear, smooth boundary.

B21t—13 to 18 inches, yellowish-red (5YR 4/8 and 4/6) clay loam; strong, fine, subangular blocky structure; firm; common roots; continuous clay films; few worm channels; few worm casts; strongly acid; clear, wavy boundary.

B22t—18 to 23 inches, yellowish-red (5YR 4/8) clay loam; few, fine, distinct, light olive-brown (2.5Y 5/4) and dark-red (2.5Y 3/6) mottles; moderate, very fine and fine, subangular blocky structure; firm; few roots; continuous clay films; few worm channels; fine, thin, yellow, red, and brown fragments of sandstone; very strongly acid; clear, smooth boundary.

B3t—23 to 28 inches, mottled, yellowish-red (5YR 4/8), strong-brown (7.5YR 5/8), and yellowish-brown (10YR 5/8) gravelly sandy clay loam; weak, fine, subangular and angular blocky structure; friable; dark-gray to light-gray and olive, thick clay films or flows on ped surfaces and at the partings and cracks of soft, weathered fragments of sandstone; very strongly acid; clear, smooth boundary.

C—28 to 44 inches, brown, soft sandstone in 1- to 3-inch lenses thinly interbedded with dark-gray and light-gray, thin lenses of clay shale; a few clay flows at the partings of the sandstone and shale; very strongly acid; clear, smooth boundary.

R—44 to 50 inches, hard, red, massive sandstone.

The A horizon is 4 to 10 inches in thickness. The Ap, or the A2, horizon is dark brown (10YR 4/3) to yellowish brown (10YR 5/4). The A2 horizon is absent in some places because of erosion or mixing that results from deep plowing. The A1 horizon in undisturbed areas is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) and is about 1 to 4 inches thick. The B1 horizon ranges from dark yellowish brown (10YR 4/4) to strong brown (7.5YR 5/6) in color and from 3 to 8 inches in thickness. The B2t horizon ranges from friable sandy clay loam to firm clay loam. In most places, if the depth to sandstone is about 30 inches or more, a B3t horizon is present. Thick grayish clay films or flows are absent in the C horizon in some places. The thickness of the B horizon is about 10 inches to more than 30 inches.

Bolivar soils are near Hector, Collinsville, Barco, Barden, and Askew soils. They are deeper to sandstone than Hector and Collinsville soils. They have a lighter colored or thinner surface layer than Collinsville, Barco, and Barden soils. Bolivar soils are not so deep as Bronaugh, Barden, and Askew soils.

Bolivar fine sandy loam, 2 to 5 percent slopes (BoB).—This soil is in convex areas on rounded ridgetops, points, side slopes, and foot slopes. The areas are of suitable shape for farming and are about 5 acres to more than 40 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Barco fine sandy loam, 2 to 5 percent slopes, and areas of Hector soils. The Barco and Hector soils each make up as much as 10 percent of the acreage mapped. The Barco soils are in the transitional area between woodland and prairie, and the Hector soils are on the breaks of side slopes. Also included are areas of Askew soils on foot slopes and areas of Barden, soils at the heads of drainageways. These together make up as much as 15 percent of the acreage mapped. Other inclusions are spots of eroded soils and areas of soils that have slopes of more than 5 percent. These inclusions together generally make up no more than 20 percent of any mapped area.

A good response to management can be expected. Because this soil is susceptible to erosion and drought, its use is limited. These limitations reduce the choice of crops, or special conservation practices are required. The soil is better suited to small grain, grasses, and legumes than to most other crops. It also is suited to sorghums, corn, and soybeans, but is not so well suited to trees, although a large acreage is now covered with oaks. The soil is well suited to berries and peach trees. It has some potential for growing alfalfa. Capability unit IIIe-4.

Bolivar fine sandy loam, 2 to 5 percent slopes, eroded (BoB2).—This soil is near the slope break on ridgetops, points, side slopes, and foot slopes. In many places the areas are small, widely separated, or dissected by drainageways. They range from 5 acres to more than 40 acres in size.

This soil has a profile similar to the one described as representative for the series, but the surface layer is about 6 inches of brown fine sandy loam. Erosion scars and gullies expose the lighter, brighter colored, somewhat finer textured subsoil in many places. Loamy erosional materials are accumulating in more nearly level areas downslope.

Included with this soil in mapping are areas of uneroded Bolivar soils and less extensive areas of severely eroded Bolivar soils. These included soils make up about 20 percent of some mapped areas. Also included are small scattered areas or spots of Hector, Barden, and Barco soils that make up as much as 10 percent of some mapped areas. The uneroded Bolivar soils are on the crests of ridgetops and along drainageways, and the severely eroded Bolivar soils are near side-slope breaks. The Hector soils are on breaks, and Barden and Barco soils are on foot slopes or at the heads of drainageways.

A fair response to management can be expected. Susceptibility to further erosion and to drought limit use of this soil. These limitations severely restrict the choice of crops or result in a need for very careful management. This soil is better suited to grasses and legumes than to most other crops. Small grain and an occasional sorghum crop can be safely grown in long rotations that include hay and pasture crops. This soil is also suited to trees. Capability unit IVe-7.

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (Br) consists of upland breaks that have scarped edges; of small, contiguous, severely eroded areas of Parsons, Barden, and Barco soils; and of very narrow bottoms of Hepler-Radley silt loams. Areas on uplands and bottom lands are about equal in extent. They are long and are 50 to 300 feet wide. Showing the soils separately on the soil map is not feasible or practical.

The soils in this mapping unit are somewhat poorly drained to well drained. Permeability ranges from very slow in the Parsons soils to moderate in the Barco and Radley soils. The available water capacity ranges from very high to low. Response to management is fair in most places but ranges to very good. Some areas of the mapping unit are wet, and other areas are dry. Susceptibility to erosion, however, is the major limitation affecting use of the soils. Capability unit VIe-7.

Bronaugh Series

The Bronaugh series consists of deep, gently sloping soils on uplands. These soils formed under native prairie vegetation in clayey to sandy shale residuum.

In a representative profile, the surface layer is dark-brown silt loam about 7 inches thick. The subsoil is about 40 inches thick. The upper 8 inches is dark reddish-brown silty clay loam, the next 10 inches is reddish-brown silty clay, the next 11 inches is red light silty clay, and the lower 11 inches is yellowish-red heavy silty clay loam. The underlying material is mottled, dark yellowish-brown, friable silty clay loam about 25 inches thick. It contains many small to large concretions.

Bronaugh soils are medium in natural fertility and are well drained. Runoff is medium, permeability is moderate, and the available water capacity is high. Susceptibility to erosion is the major limitation that affects the use of these soils.

Most areas of Bronaugh soils are cultivated. The principal crops are corn, sorghums, wheat, and soybeans. Grasses and legumes also are grown.

Representative profile of Bronaugh silt loam, 2 to 5 percent slopes, in a fescue and lespedeza meadow, 1,725 feet north and 1,375 feet west of the southeast corner of sec. 4, T. 33 N., R. 33 W.:

Ap—0 to 7 inches, dark-brown (7.5YR 3/2) silt loam, brown (7.5YR 5/4) dry; strong, fine and very fine, granular structure; very friable; many roots; few worm channels and casts; few iron and manganese concretions; medium acid; clear, smooth boundary.

B1t—7 to 15 inches, dark reddish-brown (5YR 3/4) silty clay loam; common, fine, faint, yellowish-red mottles; strong, very fine, subangular blocky structure; friable; few roots; thin patchy clay films; common worm channels and casts; common iron and manganese concretions; strongly acid; gradual, smooth boundary.

B21t—15 to 25 inches, reddish-brown (2.5YR 4/4) light silty clay; few, fine, faint, yellowish-red mottles; strong, very fine and fine, angular and subangular blocky structure; firm; few roots; thin continuous clay films; few worm channels; many iron and manganese concretions; a few black and strong-brown concretionary splotches or stains; medium acid; gradual, smooth boundary.

B22t—25 to 36 inches, red (2.5YR 4/6) light silty clay; common, medium, faint, reddish-brown mottles; moderate, fine and very fine, angular blocky structure; firm; few roots; continuous clay films; few worm channels; many iron and manganese concretions; common, black strong-brown concretionary splotches or stains; medium acid; gradual, smooth boundary.

B3t—36 to 47 inches, yellowish-red (5YR 5/6) heavy silty clay loam; common, medium, faint, strong-brown mottles; moderate to weak, fine and very fine, subangular blocky structure; firm; few roots; continuous clay films; few worm channels; many iron and manganese concretions, some more than 1 inch in diameter; medium acid; gradual, smooth boundary.

C—47 to 72 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, medium, yellowish-brown and strong-brown mottles and few, fine, faint, grayish-brown mottles; massive; friable; few roots; thick patchy clay films or flows; many iron and manganese concretions; medium acid.

The Ap horizon is dominantly dark brown (7.5YR 3/3) but ranges from dark reddish brown (5YR 3/3) to very dark brown (10YR 2/2). Texture is dominantly silt loam but ranges from loam to silty clay loam. Eroded areas are redder than uneroded areas and, in many places, are silty clay loam in texture. Base saturation is less than 50 percent in at least one horizon below the Ap horizon. The B horizon is 20 to 40 inches thick. The upper part is dark brown (7.5YR 3/2) or dark reddish brown (5YR 3/4) ranging to red (2.5YR 4/6) or dark red (2.5YR 3/6). The lower part is red (2.5YR 4/6) to yellowish red (5YR 5/6 to 4/8). Texture in the upper part ranges from silty clay loam or clay loam to silty clay. The C horizon is massive, brownish silty clay loam or clay loam that has grayish mottles. Reaction is strongly acid to medium acid throughout the profile.

Bronaugh soils are redder throughout the profile than the associated Barco, Barden, Parson, Liberal, and Collinsville. They are deeper than Barco, Liberal, and Collinsville soils.

Bronaugh silt loam, 2 to 5 percent slopes (BsB).—This soil is mainly on convex knolls and terminal points of low, rounded divides. Most areas are circular and are less than 10 acres in size.

Included with this soil in mapping are a few areas of Barco and Barden soils. Also included are small spots of eroded Bronaugh soils. A few areas of these Bronaugh soils have slopes of more than 5 percent.

A very good response to management can be expected. Because this soil is susceptible to erosion, the choice of crops is reduced or moderate conservation practices are required. The soil is well suited to corn, small grain, sorghums, soybeans, grasses, and legumes, including alfalfa. It has a potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIe–1.

Carytown Series

The Carytown series consists of deep, nearly level soils in slight depressions and on benches on uplands. These soils formed under mixed grasses in alkaline shale residuum enriched with sodium. In places these materials were covered with a thin mantle of old silty alluvium or loess (fig. 10).

In a representative profile, the surface layer is dark grayish-brown and dark-gray silt loam about 9 inches thick. The subsurface layer is grayish-brown silt loam about 6 inches thick. The upper part of the subsoil is very dark grayish-brown and olive-brown clay about 21 inches thick. It is medium to slightly acid and has common, fine, prominent, red mottles. The lower part of the subsoil is mottled, grayish-brown and light olive-brown, very firm, neutral clay about 12 inches thick. The underlying material is gray, mildly alkaline heavy silty clay loam that has distinct brownish mottles.

Carytown soils are low in natural fertility and are poorly drained. Runoff is slow, permeability is very slow, and the available water capacity is moderate. A perched water table overlies the clay subsoil in wet periods. These soils are seasonally wet or dry. Wetness caused by seepage and ponding is the major limitation that affects use of these soils. In places the soils are susceptible to erosion on the lower part of long slopes.

Most areas of these soils are used for growing corn, sorghums, or small grain. The remaining acreage is in grasses and legumes that are pastured or mowed for hay.

Representative profile of Carytown silt loam in a pasture, 875 feet east and 405 feet south of the northwest corner of sec. 19, T. 31 N., R. 29 W.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) and dark-gray (10YR 4/1) silt loam, light brownish gray (10YR 6/2) dry; weak, thin, platy structure; very friable; common roots; common worm channels and casts; few very fine fragments of chert; slightly acid; gradual, smooth boundary.

A2—9 to 15 inches, grayish-brown (10YR 5/2) silt loam; common, medium, faint, light brownish-gray mottles;

Figure 10.—Profile of Carytown silt loam. This soil has well-formed columnar structure and calcium concretions.

common, medium, distinct, brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) organic stains; weak, thin, platy structure; very friable; common roots; vesicular; common worm channels and casts; common iron and manganese concretions; medium acid; abrupt, wavy boundary.

B21t—15 to 18 inches, very dark grayish-brown (10YR 3/2) clay; common, fine, prominent, red (2.5YR 4/8) mottles and few, fine, faint, dark-gray, dark grayish-brown, and very dark gray mottles; weak, coarse, columnar structure parting to moderate, fine and very fine, angular blocky structure; extremely firm; few roots; thick continuous clay films; few worm channels and casts; many iron concretions; few very fine fragments of chert; medium acid; gradual, smooth boundary.

B22t—18 to 25 inches, very dark grayish-brown (10YR 3/2) and olive-brown (2.5Y 4/4) clay; few, fine, faint, very dark gray and yellowish-brown mottles; moderate, fine and very fine, angular blocky structure; extremely firm; few roots; thick continuous clay films; few iron concretions; few very fine fragments of chert; slightly acid; gradual, smooth boundary.

B23t—25 to 36 inches, olive-brown (2.5Y 4/4) clay; few, fine, faint, very dark grayish-brown and yellowish-brown mottles; moderate, fine, angular blocky structure; extremely firm; few roots; thick continuous clay films; few iron and manganese concretions; slightly acid; gradual, smooth boundary.

B3t—36 to 48 inches, mottled grayish-brown (2.5Y 5/2) and light olive-brown (2.5Y 5/4) clay; few, fine, distinct, strong-brown (7.5YR 5/8) mottles and few, fine, faint, gray mottles; weak, fine and medium, subangular and angular blocky structure; very firm; few roots; thick continuous clay films; few iron and manganese concretions; neutral; gradual, smooth boundary.

C—48 to 72 inches, gray (5Y 5/1) heavy silty clay loam; few, fine, distinct, strong-brown (7.5YR 5/8) mottles and few, fine, faint, gray and dark-gray mottles; massive; firm; thick patchy clay films; mildly alkaline.

The A horizon ranges from 4 to about 20 inches in thickness. The color of the A1 horizon, or the Ap horizon, is dominantly dark grayish brown (10YR 4/2) but ranges to dark gray (10YR 4/1). The A2 horizon ranges from gray (10YR 5/1) to light brownish gray (10YR 6/2). The A2 horizon is dominantly medium acid to very strongly acid but ranges to neutral in slick spots and where the surface layer has been limed. Small slick spots, locally called buffalo wallows, are present in these soils. On eroded spots and in some small, flat, uneroded areas, the depth to the subsoil is extremely variable.

The B2t horizon ranges from olive brown (2.5Y 4/4) to very dark gray (10YR 3/1). Red mottles are absent in the B21t in some places. The B3t horizon ranges from dark gray (10YR 4/1) to light olive gray (5Y 6/2). The Bt horizon ranges from 30 to 45 inches in total thickness. Reaction, to a depth of 30 inches, ranges from medium acid to moderately alkaline. Below a depth of 30 inches, the B and C horizons range from neutral to strongly alkaline. Calcium concretions and gypsum crystals are present in many places.

The Carytown soils are associated with Parsons, Cherokee, Summit, and Askew soils. They are alkaline in the lower part of the subsoil and in the underlying material, and this distinguishes them from Parsons and Cherokee soils. The abrupt change in texture from the subsurface layer to the subsoil distinguishes them from Summit and Askew soils.

Carytown silt loam (Ca).—This soil is in depressions and on benches that receive seepage and runoff from higher slopes. It also is on saddles that cross ridgetops. Areas are about 10 acres to 1,000 acres in size.

Included with this soil in mapping are areas of Parsons, Summit, and Lanton soils. The Parsons soils make up as much as 10 percent of the acreage mapped; the Summit soils, 10 percent; and the Lanton soils, 5 percent. Also included are small areas of Cherokee silt loam. The Summit soils are on foot slopes and side slopes, the Lanton soils are on flood plains and in depressions, and the Cherokee and Parsons soils are at high elevations on ridgetops and benches. Other inclusions are slick spots, spots or streaks of eroded soils, and small scattered areas of soils that are more sloping than Carytown silt loam. Combined, the inclusions in this mapping unit generally make up no more than 25 percent of the acreage mapped.

A fair response to management can be expected. The soil is seasonally wet, and to a lesser degree, it is seasonally dry. It is susceptible to erosion where slopes are long. Because of these limitations, the choice of crops is reduced or special conservation practices are required. This soil is suited to sorghums, small grain, grasses, legumes, corn, and soybeans. Sweetclover grows on slick spots. This soil has potential for growing vegetables and field crops if it is irrigated. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIIw-12.

Cherokee Series

The Cherokee series consists of deep, nearly level soils on stream terraces, on upland benches, and in depressions in all parts of the county. These soils formed under mixed trees and grasses in old silty alluvium and shale residuum that are covered in most places with a thin mantle of loess.

In a representative profile, the surface layer is dark grayish-brown silt loam about 7 inches thick. The subsurface layer is grayish-brown silt loam about 11 inches thick. The upper part of the subsoil is very dark gray and dark-gray, very strongly acid clay about 24 inches thick. It has prominent, dark-red mottles and faint, grayish and brownish mottles. The lower part of the subsoil is coarsely mottled grayish-brown, dark-gray, and light olive-brown heavy silty clay loam about 21 inches thick. It is firm and is extremely acid. The underlying material is coarsely mottled light-gray and yellowish-brown silty clay loam. It is firm and is very strongly acid.

Cherokee soils are low in natural fertility and are somewhat poorly drained. Runoff is slow to medium, permeability is slow, and the available water capacity is high. A temporary perched water table overlies the very firm subsoil in wet periods. Wetness is the major limitation that affects use of these soils.

Most areas of these soils are in corn, sorghum, wheat, and soybeans. A smaller acreage is in grasses and legumes that are pastured or mowed for hay.

Representative profile of Cherokee silt loam in a meadow of redtop and white clover, 1,585 feet east and 660 feet north of the southwest corner of sec. 3, T. 31 N., R. 29 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; common, medium, faint, dark-gray mottles and few, fine, faint, dark yellowish-brown mottles; weak, medium and thick, platy structure; very friable; common roots; common worm channels and casts; common iron and manganese concretions; slightly acid; abrupt, smooth boundary.

A2—7 to 18 inches, grayish-brown (10YR 5/2) silt loam; many, fine, faint, light brownish-gray mottles and few, fine, faint, dark yellowish-brown mottles; moderate, thick and medium, platy structure; very friable; few roots; vesicular, common worm channels and dark grayish-brown casts; common iron and manganese concretions; strongly acid; abrupt, wavy boundary.

B21t—18 to 27 inches, very dark gray (10YR 3/1) clay; few, medium, prominent, dark-red (2.5YR 3/6) mottles; common, medium, faint, dark-gray mottles; and few, fine, faint, gray and dark yellowish-brown mottles; moderate, fine and medium, angular blocky structure; very firm; few roots; thick continuous clay films; few worm channels; common iron and manganese concretions; very strongly acid; clear, smooth boundary.

B22t—27 to 42 inches, dark-gray (10YR 4/1) clay; few, medium, prominent, dark-red (2.5YR 3/6) and reddish-brown (2.5YR 5/4) mottles and common, medium, faint, very dark gray, grayish-brown, and gray mottles; weak, fine and medium, angular blocky structure; very firm; few roots; thin continuous clay films; few worm channels; common iron and manganese concretions; very strongly acid; clear, smooth boundary.

B3t—42 to 63 inches, coarsely mottled, grayish-brown (10YR 5/2), dark-gray (10YR 4/1), and light olive-brown (2.5Y 5/4) heavy silty clay loam; few, medium, prominent, dark-red (2.5YR 3/6) mottles and fine, faint, gray and yellowish-brown mottles; weak, coarse and medium, subangular blocky structure; firm; few roots; thin patchy clay films; few worm channels; common iron and manganese concretions; extremely acid; gradual, smooth boundary.

C—63 to 72 inches, coarsely mottled light-gray (10YR 6/1) and yellowish-brown (10YR 5/6) silty clay loam; few, fine, faint, gray, grayish-brown, very dark gray, and strong-brown mottles; massive; firm; few roots; thin patchy clay films; few worm channels; common iron and manganese concretions; very strongly acid.

The A horizon ranges from 6 to 20 inches in thickness and is medium acid or strongly acid. In some places the A2 horizon is absent because of erosion or mixing that results from deep plowing. The A1 horizon, or the Ap horizon, is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) but ranges to gray (10YR 5/1) or grayish brown (10YR 5/2) in eroded areas. The A2 horizon ranges from grayish brown (10YR 5/2) to very pale brown (10YR 7/3). Mottles that have high chroma are present. Iron and manganese concretions, larger than 2 millimeters in diameter, are also present in this layer. The coarsely mottled B2t horizon ranges from 16 to 30 inches in thickness. The base color in the top part is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The dominant color in the lower part ranges from very dark gray (10YR 3/1) to grayish brown (10YR 5/2). The B3t horizon is light silty clay or heavy silty clay loam. The Bt horizon ranges from slightly acid to extremely acid.

Cherokee soils are associated with Hepler, Parsons, Carytown, and Askew soils. They have a lighter colored or thinner surface layer than Hepler and Parsons soils. The abrupt, lower boundary of the surface layer distinguishes them from Hepler and Askew soils. The underlying material in Cherokee and Parsons soils is acid, but it is alkaline in Carytown soils.

Cherokee silt loam (Ce).—This nearly level soil is on the ridgetops of high stream terraces and benches and in depressions. Areas are about 10 acres to more than 40 acres in size.

Included with this soil in mapping are areas of Parsons and Askew soils and small areas of Carytown soils. The Parsons soils make up about 15 percent of the mapped acreage, and the Askew soils about 5 percent. The Parsons soils are in slightly convex areas on uplands. The Carytown soils are in depressions, and the Askew soils are at lower elevations adjacent to bottoms. Also included is a small acreage of a soil that is very similar to Cherokee soils, except that the surface layer is darker colored and thicker. This included soil is in depressions near drainageways. Other inclusions are spots or streaks of eroded soils, and small scattered areas of soils that are more sloping than Cherokee silt loam.

A good response to management can be expected. Seasonal wetness caused by ponding and a perched water table limit the use of this soil. These factors reduce the choice of crops or make special conservation practices necessary.

This soil is suited to sorghums, small grain, soybeans, corn, grasses, and legumes. It has potential for growing vegetables and field crops under irrigation. The acreage that can be irrigated is limited to some degree by the availability of an adequate supply of water. Capability unit IIw-1.

Cleora Series

The Cleora series consists of deep, nearly level soils on bottom lands. These soils formed in stratified, recent, moderately coarse textured sediment washed from fine sandy loam soils of nearby uplands. Cleora soils are in all parts of the county.

In a representative profile, the surface layer is dark-brown fine sandy loam about 18 inches thick. It is strongly acid. The upper 32 inches of the underlying material is brown and dark-brown, stratified, acid fine sandy loam. Below this is mottled, grayish-brown, medium acid

gravelly fine sandy loam that is underlain by unconsolidated sandstone fragments.

Cleora soils are medium in natural fertility and are well drained. Runoff is slow, permeability is moderately rapid, and the available water capacity is moderate. Wetness caused by frequent overflow is the major limitation that affects use of these soils. These soils have a good potential for growing walnut trees, other valuable trees, and alfalfa.

Most areas of these soils are in grass, brush, and timber. Row crops, small grain, grass, and legumes are grown in cultivated areas.

Representative profile of Cleora fine sandy loam, in a permanent pasture of broomsedge, wild grasses, and a few sumac, 2,050 feet south and 2,340 feet west of the northeast corner of sec. 30, T. 33 N., R. 29 W.:

A—0 to 18 inches, dark-brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak, very fine, granular structure; very friable; common roots; common worm channels and casts; few iron concretions; strongly acid; gradual, smooth boundary.

C1—18 to 34 inches, brown (10YR 4/3) fine sandy loam; common, fine, faint, dark-brown mottles; massive; very friable; few roots; vesicular; few worm channels and casts; few manganese and iron concretions; strongly acid; gradual, smooth boundary.

C2—34 to 50 inches, dark-brown (10YR 3/3) fine sandy loam; common, coarse, faint, very dark grayish-brown and brown mottles; massive; very friable; common manganese and iron concretions; strongly acid; gradual, smooth boundary.

IIC—50 to 60 inches, grayish-brown (10YR 5/2) gravelly fine sandy loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; very friable; many manganese and iron concretions; common, dark-colored concretionary smears or stains; medium acid.

IIR—60 to 70 inches, brownish, unconsolidated fragments of sandstone that are stained with darker colors.

The A horizon ranges from dark brown (10YR 3/3) to very dark brown (10YR 2/2) in color and from 10 to 20 inches in thickness. Texture is mainly fine sandy loam but ranges to loam or, in a few places, to loamy fine sand. The C horizon is dark brown (10YR 4/3), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4) in the upper part. It ranges from dark brown (10YR 3/3) to yellowish brown (10YR 5/6) or grayish brown (10YR 5/2) in the lower part. It is fine sandy loam in most places but ranges from sandy loam to loam. Depth to the gravelly IIC horizon is from 40 inches to several feet. The Cleora soils are strongly acid to medium acid in upland drainageways but range to neutral near the larger streams. Depth to bedrock is more than 50 inches.

These soils are more strongly acid than is within the defined range for the Cleora series, but this does not alter their usefulness or behavior.

Cleora soils are on flood plains of small creeks or near the channel of larger streams. They are coarser textured than the associated Radley, Verdigris, and Hepler soils.

Cleora fine sandy loam (Cf).—This nearly level soil is on the flood plains of small creeks and near the channel of larger streams. Most areas are long and narrow and are cut in many places by stream channels; many areas are poorly shaped for farming. Areas are less than 5 acres to more than 40 acres in size.

Included with this soil in mapping are small scattered areas of Radley and Verdigris silt loams. Also included are areas of soils that are very similar to Cleora soils, except that the surface layer is lighter colored or thinner. Most areas of these soils are along small tributaries of Horse Creek that receive sediment washed from the nearby light-colored Bolivar and Hector soils.

A good response to management can be expected. The soil is frequently wet from overflow and also is seasonally droughty. Because of these limitations, the choice of plants is reduced or special conservation practices are required, or both. This soil is well suited to small grain, grass, and legumes, including alfalfa. Because of seasonal droughtiness, it is not so well suited to corn, soybeans, and sorghums as it is to other crops. Capability unit IIIw-2.

Collinsville Series

The Collinsville series consists of soils on uplands. These soils have a loamy surface layer and are underlain by hard sandstone at a depth of less than 20 inches (fig. 11). Sandstone fragments are on the surface and throughout the soil. These soils are on low divides or mounds near streams in all parts of the county but the southeastern corner. They formed under tall prairie grasses in standstone residuum. In places the sandstone is interbedded with thin layers of shale.

In a representative profile, the surface layer is dark-brown, medium acid fine sandy loam about 10 inches thick. The subsoil is dark yellowish-brown gravelly fine sandy loam about 3 inches thick. Yellowish-brown sandstone is

Figure 11.—**Profile of Collinsville fine sandy loam, 5 to 14 percent slopes.**

at a depth of 13 inches. It is fractured, and the cracks are filled with brownish fine earth. Below this are thick layers of brownish, hard and soft sandstone that are interbedded with thin layers of shale.

Collinsville soils are low in natural fertility and are well drained. Permeability is moderately rapid, and the available water capacity is very low. Droughtiness is the major limitation that affects use of these soils. Susceptibility to erosion, stoniness, and rockiness also are limitations.

Most areas of these soils are in native grasses that are mowed for hay or pastured. A small acreage is in tame grasses, legumes, small grain, and sorghums. In most places cultivated areas of Collinsville soils are closely associated with and include Barco soils.

Representative profile of Collinsville fine sandy loam, 5 to 14 percent slopes, in an area of native grasses and sumac, 290 feet north and 20 feet east of the southwest corner of sec. 4, T. 33 N., R. 30 W.:

A1—0 to 10 inches, dark-brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; moderate, very fine and fine, granular structure; very friable; common roots; few worm channels and casts; few fragments of sandstone; medium acid; clear, wavy boundary.

B—10 to 13 inches, dark yellowish-brown (10YR 4/4) gravelly fine sandy loam; weak and moderate, fine and medium, granular structure; very friable; few roots; few iron and manganese concretions; about 30 percent hard and soft fragments of sandstone; strongly acid; abrupt, wavy boundary.

R1—13 to 25 inches, yellowish-brown, hard sandstone that is fractured at 1- to 3-foot intervals; brownish fine earth and fragments of sandstone (10 percent of the mass) fill the cracks.

R2—25 to 50 inches, brownish, hard and soft sandstone interbedded with thin layers of shale.

The A horizon ranges from very dark brown (10YR 2/2) to dark brown (7.5YR 3/2) and is fine sandy loam or loam. Thickness ranges from 4 to about 20 inches, and the reaction is strongly acid to slightly acid. The B horizon is absent in many places where the depth to hard sandstone is less than about 10 inches. Where present, the B horizon ranges from brown (10YR 4/3) to strong brown (7.5YR 5/6). A C horizon is present in some places. It is similar to the B horizon but lacks structure.

Collinsville soils are associated with Hector, Bolivar, Barco, Liberal, Barden, and Bronaugh soils. They have a darker colored or thicker surface layer than Hector and Bolivar soils. They are shallower and contain less clay than Bolivar, Barco, Liberal, Barden, and Bronaugh soils.

Collinsville fine sandy loam, 2 to 5 percent slopes (CoB).—This soil is in convex areas on knobs, ridgetops, points, and side slopes. Bedrock outcrops are common, but only a few slopes are broken. Areas are long and relatively wide and are about 5 acres to more than 100 acres in size.

Included with this soil in mapping are areas of Barco, Hector, Liberal, and Barden soils and areas of stony, rocky, and eroded Collinsville soils that are slightly steeper than Collinsville fine sandy loam, 2 to 5 percent slopes. The Barco soils make up 15 percent of the mapped acreage; the Hector soils, 5 percent; the Liberal and Barden soils together, 5 percent; and the included Collinsville soil, as much as 5 percent. These inclusions together generally make up no more than 25 percent of any area mapped. In most places the Barco and Barden soils are in narrow bands between or below breaks. The Hector soils are in the transitional belt between prairie and timberland. The Liberal soils are on knobs. Also included are a few stony areas.

Runoff is medium. A fair response to management can be expected. Droughtiness and stony, rocky, and eroded spots severely restrict the choice of crops. Because of these limitations, very careful management is required. The soil is better suited to grasses and legumes than to other crops. It also is suited to small grain and an occasional sorghum crop, if they are grown in long rotations that include hay crops. Capability unit IVs–8.

Collinsville fine sandy loam, 5 to 14 percent slopes (CoD).—This soil is in convex areas on breaks, ridgetops, points, and side slopes. Stony spots and bedrock outcrops are common, but only a few slopes are broken. Bedrock escarpments make up the lower boundary of some mapped areas. Areas are long and relatively narrow and are 10 acres to more than 100 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Hector soils and stony Collinsville soils. The Hector soils make up about 10 percent of the mapped acreage. They are in the transitional area between prairie and woodland, and the stony Collinsville soils are on the breaks. Also included are a few areas of Cleora fine sandy loam and Hepler-Radley silt loams.

Runoff is medium to rapid. A fair response to management can be expected. Droughtiness, susceptibility to erosion, and stony and rocky spots make this soil generally unsuitable for cultivation. The use of this soil is mostly limited to pasture, woodland, and wildlife habitat. This soil is better suited to grasses and legumes (fig. 12) than it is to other crops. Capability unit VIs–8.

Collinsville stony fine sandy loam, 2 to 14 percent slopes (CrD).—This stony soil is on breaks, points, side slopes, and narrow tops of ridges. Bedrock outcrops are common, and many slopes are broken. Nonstony areas also are common. Bedrock escarpments make up the lower boundary of some areas mapped. Areas are long and narrow and are about 5 acres to more than 40 acres in size. This soil has a profile similar to the one described as representative for the series, except that stones are on the surface and in the profile and the surface layer is somewhat thinner. Stones are longer than they are wide and from 5 to about 100 feet apart.

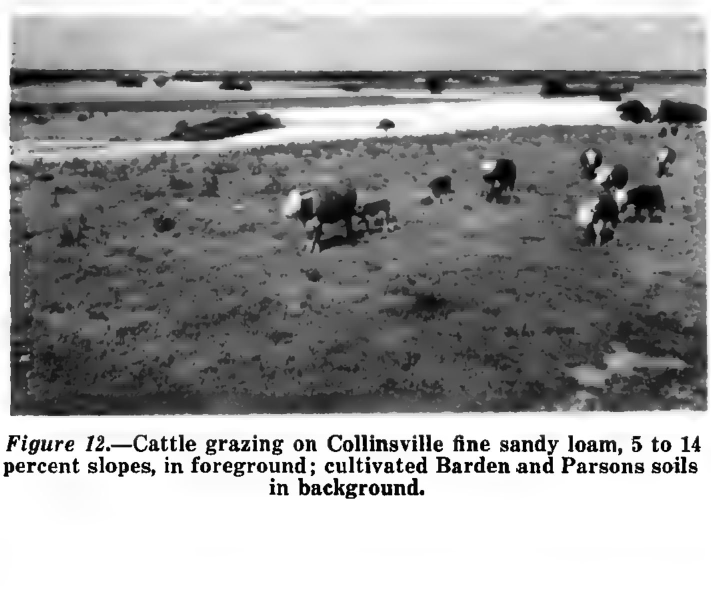

Figure 12.—**Cattle grazing on Collinsville fine sandy loam, 5 to 14 percent slopes, in foreground; cultivated Barden and Parsons soils in background.**

Included with this soil in mapping are areas of Hector soils and of Collinsville fine sandy loam, 5 to 14 percent slopes. The Hector and Collinsville soils each make up about 10 percent of the mapped acreage. Also included are small areas of soils that have slopes of more than 14 percent. Other inclusions are a few areas of Cleora fine sandy loam and Hepler-Radley silt loams on very narrow bottoms.

This Collinsville soil has rapid runoff. Stones on the surface or in the surface layer and rocky spots make this droughty soil unsuitable for cultivation. All use of farm machinery is impractical. Only small, scattered, nonstony inclusions of Collinsville and other soils can be mowed or worked for hay or pasture crops. These very severe limitations restrict the use of this soil mostly to grazing, woodland, and wildlife habitat. A poor response to management can be expected. This soil is in native prairie vegetation and brush. It is better suited to grazing and wildlife habitat than to other uses. Capability unit VIIs-10.

Creldon Series

The Creldon series consists of deep, nearly level to gently sloping soils on uplands. These soils have a firm fragipan at a depth of 18 to 36 inches. They formed under tall prairie grasses in cherty limestone residuum that was covered with a thin mantle of loess or old silty alluvium in many places.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 10 inches thick. It is very strongly acid. The subsoil is dark yellowish-brown and yellowish-brown, very strongly acid silty clay loam in the upper 10 inches. It has brownish and reddish mottles and is cherty near the lower part. Below this is a fragipan of mottled brownish, grayish, and reddish very cherty silty clay loam about 25 inches thick. It is firm and extremely acid to very strongly acid. Below the fragipan, the subsoil is coarsely mottled, reddish, brownish, and grayish cherty clay that is very strongly acid.

Creldon soils are medium in natural fertility and are moderately well drained. Runoff is slow. Permeability above the fragipan is moderate, but it is slow in the fragipan. Available water capacity is moderate. Because the fragipan is at a moderate depth, these soils are somewhat droughty. Susceptibility to erosion, however, is the major limitation that affects their use.

Most areas of these soils are cultivated. The principal crops are corn, wheat, sorghums, soybeans, grasses, and legumes. Except for part of the corn, the grain is marketed as a cash crop. The grasses and legumes are pastured or mowed for hay. A few acres are in native prairie grasses that are mowed for hay or pastured.

Representative profile of Creldon silt loam, 1 to 4 percent slopes, in a redtop meadow, 740 feet east and 250 feet south of the northwest corner of sec. 8, T. 31 N., R. 29 W.:

A—0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate, very fine, granular structure; very friable; common roots; common worm channels and casts; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

B1—10 to 14 inches, dark yellowish-brown (10YR 4/4) silty clay loam; few, fine, faint, brown mottles; moderate, very fine, subangular blocky structure; friable; common roots; many worm channels and few very dark grayish-brown casts; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

B2t—14 to 20 inches, yellowish-brown (10YR 5/4) silty clay loam; common, medium, distinct, dark-red (2.5YR 3/6) and red (2.5YR 4/8) mottles and few, fine, faint, brown mottles; moderate, very fine, subangular blocky structure; firm; few roots; thin clay films; common worm channels and casts; few iron and manganese concretions; about 20 percent fragments of chert near the lower boundary; very strongly acid; clear, wavy boundary.

IIA'x—20 to 28 inches, grayish-brown (10YR 5/2) very cherty silty clay loam; few, medium, faint, yellowish-brown (10YR 5/6) mottles; massive; firm, few roots; thin patchy clay films; about 60 percent fragments of chert; extremely acid; clear, wavy boundary.

IIB'x—28 to 36 inches, mottled light brownish-gray (10YR 6/2) yellowish-red (5YR 5/8), dark-red (2.5YR 3/6), yellowish-brown (10YR 5/8), and light-gray (10YR 7/2) very cherty silty clay loam; massive; firm; few roots; thick patchy clay films; about 70 percent fragments of chert; extremely acid; clear, wavy boundary.

IIB'x2—36 to 45 inches, mottled reddish-brown (5YR 4/4), yellowish-red (5YR 4/6), gray (5Y 5/1), and light-gray (10YR 6/1) very cherty silty clay loam; massive; firm; few roots; thick patchy clay films and common gray clay flows; few iron concretions; strongly acid; gradual, smooth boundary.

IIB2bt—45 to 60 inches, coarsely mottled red (2.5YR 4/8), yellowish-brown (10YR 5/8), pale-brown (10YR 6/3), and light-gray (10YR 7/2) cherty clay, few, medium, distinct, very dark grayish-brown (10YR 3/5) mottles and faint, dark-red mottles; weak, very fine, angular blocky structure; very firm; continuous clay films; few iron and manganese concretions; about 20 percent fragments of chert; an occasional stone-size fragment of chert at a depth of about 60 inches; very strongly acid.

The Ap horizon, or the A1 horizon, ranges from 6 to 18 inches in thickness. Except where the surface layer has been limed, these soils are strongly acid or medium acid. Where the surface layer has been limed, they range to neutral. In most places the surface layer contains a few fragments of chert. The B horizon is 10 to 22 inches thick and ranges from slightly acid to strongly acid. The B1 horizon ranges from dark brown (7.5YR 3/2) to dark yellowish brown (10YR 4/4) in color and from 3 to 8 inches in thickness. The B2t horizon ranges from strong brown (7.5YR 5/6) to dark yellowish brown (10YR 4/4) and is silty clay loam, light silty clay, or cherty analogues. Mottles that have a chroma of 2 or less and a value of 4 or more are in the upper 10 inches of the B horizon in many places. The fragipan ranges from 8 to 40 inches in thickness and from strongly acid to extremely acid. The chert content of the fragipan is less than 35 to about 80 percent. The upper part of the fragipan has less than 15 percent chert in some places. The underlying material ranges from strongly acid to extremely acid in the top part and from very strongly acid to slightly acid in the lower part. In a few places, the chert content is more than 35 percent.

The Creldon soils are associated with Keeno, Nixa, Lebanon, Newtonia, and Parsons soils. They have less fragments of chert from the surface down to the fragipan than the Keeno and Nixa soils. They have a darker colored or thicker surface layer than Nixa and Lebanon soils. The presence of a fragipan distinguishes them from Newtonia and Parsons soils. A gradual change in texture from the surface layer to the subsoil also distinguishes Creldon soils from Cherokee, Parsons, and Carytown soils.

Creldon silt loam, 1 to 4 percent slopes (CsB).—This soil is in convex areas on ridgetops, side slopes, and foot slopes. Areas are long and relatively narrow and are about 5 acres to more than 30 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Parsons silt loam, 1 to 3 percent slopes. Also included are areas of a soil that is similar to the Parsons soil, except that it has a fragipan. This soil and the Parsons soil are on the crests of ridgetops. Each makes up no more than 5 percent of the acreage mapped. Other inclusions are small scattered areas of Keeno soils and a few spots of eroded Creldon soils.

This Creldon soil has moderate available water capacity. A good response to management can be expected. Susceptibility to erosion and droughtiness reduces the choice of crops or require special conservation practices, or both. The soil is suited to wheat, sorghums, corn, soybeans, grasses, and legumes, including alfalfa. Capability unit IIIe-5.

Creldon silt loam, 1 to 4 percent slopes, eroded (CsB2).—This soil is near the break on the lower part of slopes, on ridgetops, side slopes, and foot slopes. Areas are widely separated or are dissected by drainageways. They are less than 5 acres to more than 20 acres in size. This soil has a profile similar to the one described as representative for the series, except that it has a thinner surface layer. Because of erosion the surface layer of very dark grayish-brown silt loam is about 6 inches in thickness. Erosion scars and a few gullies expose the brighter colored, finer textured subsoil in many places.

Included with this soil in mapping are areas of Keeno soils on side slopes along drainageways. The Keeno soils make up as much as 10 percent of areas mapped. Also included are small scattered areas of cherty, severely eroded and uneroded Creldon soils.

This Creldon soil has low available water capacity. A fair response to management can be expected. Susceptibility to further erosion and droughtiness severely limit the use of this soil. The choice of crops is restricted, and very careful management is required. This soil is better suited to grasses, legumes, and small grain than it is to other crops. An occasional crop of sorghum or other row crop can be grown in long rotations that include hay or pasture crops. Capability unit IVe-7.

Creldon silt loam, deep, 1 to 4 percent slopes (CtB).—This soil is in convex areas on ridgetops, side slopes, and foot slopes. Areas are long and relatively wide and are about 5 acres to more than 50 acres in size. This soil has a profile similar to the one described as representative for the series, except that the layers above the fragipan are thicker and the fragipan is thinner and is at a depth of 30 inches or more.

Included with this soil in mapping are areas of Parsons silt loam, 1 to 3 percent slopes. Also included are areas of a soil that is similar to the Parsons soil, except that it has a fragipan. This soil and the Parsons soil are on the crests of ridgetops. Each soil makes up no more than about 5 percent of the acreage mapped. Other inclusions are small scattered areas of Keeno soils and a few spots of eroded Creldon soils.

This Creldon soil has moderate available water capacity. A very good response to management can be expected. Susceptibility to erosion reduces the choice of crops or requires moderate conservation practices. The soil is suited to corn, sorghums, small grain, soybeans, grasses, and legumes, including alfalfa. It has potential for growing corn and vegetables under irrigation. Capability unit IIe-2.

Hector Series

The Hector series consists of gently sloping to moderately steep soils on uplands that are underlain by sandstone at a depth of less than 20 inches (fig. 13). Sandstone fragments are on the surface and throughout the soil. These soils are on low upland divides, mostly near Horse and Little Dry Wood Creeks and the Little North Fork of the Spring River. They formed under timber in sandstone residuum. Some of the sandstone is interbedded with thin layers of shale.

In a representative profile, the surface layer is dark-brown, very strongly acid fine sandy loam about 3 inches thick. The subsurface layer is brown fine sandy loam 6 inches thick. The subsoil is yellowish-brown, gravelly fine sandy loam about 4 inches thick. Hard, yellowish-brown sandstone is at a depth of 13 inches. It is fractured, and the cracks are filled with brownish fine earth and sandstone fragments. Below this is hard and soft sandstone interbedded with thin layers of shale.

Hector soils are low in natural fertility and are well drained. Permeability is rapid, and the available water capacity is very low. Droughtiness, caused by shallow depth and moderately coarse texture, is the major limitation that affects use of these soils. Susceptibility to erosion, stoniness, and rockiness also are limitations.

More than half the acreage of these soils is in oak timber and brush. Most cleared areas are in tame grasses, lespedeza, and broomsedge. A few acres are in small grain and sorghums. In most places, cultivated areas of Hector soils are closely associated with and include areas of Bolivar soils.

Representative profile of Hector fine sandy loam, 5 to 14 percent slopes, in an area of native grasses and sumac,

***Figure 13.*—Profile of Hector fine sandy loam, 5 to 14 percent slopes. A cover of sumac, broomsedge, and grasses is in foreground, and oaks are in the background.**

2,455 feet south and 20 feet west of the northeast corner of sec. 16, T. 33 N., R. 29 W.:

A1—0 to 3 inches, dark-brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; moderate, very fine and fine, granular structure; very friable; common grass roots and a few woody roots; few fragments of sandstone; very strongly acid; clear, smooth boundary.

A2—3 to 9 inches, brown (10YR 5/3) fine sandy loam; weak, medium, platy structure and fine and very fine, granular structure; very friable; few roots; few iron and manganese concretions; few fragments of sandstone; very strongly acid; clear, smooth boundary.

B—9 to 13 inches, yellowish-brown (10YR 5/4) gravelly fine sandy loam; very weak, fine, granular and subangular blocky structure; very friable; few roots; about 20 percent soft and hard fragments of sandstone; strongly acid; abrupt, wavy boundary.

R1—13 to 21 inches, yellowish-brown sandstone; hard; fractured at 1- to 3-foot intervals; brownish fine earth and fragments of sandstone (less than 10 percent of the mass) fill the cracks.

R2—21 to 40 inches, brownish, hard and soft sandstone interbedded with thin layers of shale.

The A1 horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 4/3) in color and from 1 to 5 inches in thickness. The Ap horizon, or the A2 horizon, ranges from dark brown (10YR 4/3) to light yellowish brown (10YR 6/4). Total thickness of the surface layer ranges from 4 to 15 inches. Texture is dominantly fine sandy loam but ranges from loam to loamy fine sand. Reaction ranges from strongly acid to slightly acid. The B horizon ranges from dark brown (10YR 4/3) to strong brown (7.5YR 5/8). It has weak or moderate, granular structure. The C horizon, where present, is similar to and has the same color range as the B horizon, but it lacks structure.

Hector soils are near soils of the Collinsville, Barco, and Bolivar series. They have a lighter colored or thinner surface layer than Collinsville and Barco soils. They have more sand and less clay than Barco and Bolivar soils and are not as deep as those soils.

Hector fine sandy loam, 2 to 5 percent slopes (HcB).—This soil is in convex areas on knobs, ridgetops, points, and side slopes. Areas are about 5 acres to more than 80 acres in size. They are long and relatively wide and are well shaped for farming.

Included with this soil in mapping are areas of Bolivar and Collinsville soils and areas of stony, rocky, eroded Hector soils that are steeper than this Hector soil. The Bolivar soils make up as much as 20 percent of the acreage mapped; the Collinsville soils, as much as 10 percent; and the included Hector soils, as much as 5 percent. These inclusions together rarely make up more than 25 percent of any mapped area. The Bolivar soils are in narrow bands between or below breaks, and the Collinsville soils are in the transitional belt between woodland and prairie.

Runoff is medium. Droughtiness, susceptibility to erosion, and stony, rocky, and eroded spots are limitations affecting use of this soil. The choice of crops is restricted, but a fair response to very careful management can be expected. The soil is better suited to grasses and legumes than to other plants, but small grain or an occasional row crop can be grown in rotations that include several years of meadow. Capability unit IVs–8.

Hector fine sandy loam, 5 to 14 percent slopes (HcD).—This soil is in convex areas on breaks, ridgetops, points, and side slopes. Only a few slopes are broken. Bedrock escarpments mark the lower boundary of some areas. Areas are long and are about 10 acres to more than 80 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Collinsville and stony Hector soils. Soils of each series make up as much as 10 percent of the acreage mapped. The Collinsville soils are in the transitional area between timberland and prairie, and the stony Hector soils are on breaks. Also included are areas of Hector fine sandy loam, 2 to 5 percent slopes, near the crest of ridgetops. This included soil makes up about 10 percent of the acreage mapped. Other inclusions are a few areas of Cleora, Hepler, and Radley silt loams on narrow bottoms. All of these inclusions together generally make up no more than 25 percent of any mapped area.

Runoff is medium to rapid. A fair response to management can be expected. Droughtiness, susceptibility to erosion, and stony and rocky spots make this soil generally unsuitable for cultivation and limit its use to pasture, woodland, and wildlife habitat. The soil is better suited to grasses and legumes than to other plants. Capability unit VIs–8.

Hector stony fine sandy loam, 2 to 14 percent slopes (HeD).—This soil is on breaks, ridgetops, points, and side slopes. Bedrock escarpments mark the lower boundary of many areas. Small to large bedrock outcrops are common, especially near the Vernon County line and little Dry Wood Creek. Areas are long and are about 10 acres to more than 100 acres in size. This soil has a profile similar to the one described as representative for the series, except that stones are on the surface or in the surface layer and the surface layer is thinner. Stones are longer than they are wide and are about 5 to 100 feet apart.

Included with this soil in mapping are areas of Collinsville soils and areas of Hector fine sandy loam, 5 to 14 percent slopes. Each of these soils makes up as much as 10 percent of the acreage mapped. Also included are areas of Hector stony fine sandy loam, 14 to 30 percent slopes, on side-slope breaks. This included soil makes up as much as 10 percent of the acreage mapped. Other inclusions are areas of Cleora fine sandy loam and Hepler-Radley silt loams on very narrow bottoms.

Runoff is rapid. Stones on the surface or in the surface layer and rocky spots make this droughty soil unsuitable for cultivation. Use of farm machinery is impractical. Only small, scattered, nonstony inclusions of other soils can be mowed or worked for pasture or hay crops. These very severe limitations restrict the use of this soil to grazing, wildlife habitat, and woodland. Cleared areas are better suited to grazing than to other uses. This soil, especially the steeper broken slopes, generally has limited suitability for woodland. The inclusions of other soils on narrow bottoms however, are well suited to woodland. All areas are suited to wildlife habitat. A poor response to management can be expected. Capability unit VIIs–10.

Hector stony fine sandy loam, 14 to 30 percent slopes (HeE).—This soil is on sideslope breaks. There are many small to large bedrock outcrops, especially near the Vernon County line and Little Dry Wood Creek. Bedrock escarpments mark the lower boundary of most areas. Areas are very narrow and are 10 acres to more than 8C acres in size. This soil has a profile similar to the one described as representative for the series, except that stones are on the surface and in the surface layer and the

surface layer is somewhat thinner. Stones are longer than they are wide and are about 5 to 50 feet apart.

Included with this soil in mapping are areas of Hector stony fine sandy loam, 5 to 14 percent slopes, that make up as much as 20 percent of the acreage mapped. Also included are a few areas of Cleora fine sandy loam and Hepler-Radley silt loams on very narrow bottoms.

Runoff is rapid. Stones on the surface or in the surface layer, the many rocky spots, and steep slopes make this droughty soil unsuitable for cultivation. Use of farm machinery is impractical. These very severe limitations restrict the use of this soil mostly to grazing, woodland, or wildlife habitat. A large acreage is in short oak timber and brush. The soil is better suited to wildlife habitat than to other uses. It is also suited, to a limited degree, to grazing or woodland. A poor response to management can be expected. Capability unit VIIs-10.

Hepler Series

The Hepler series consists of deep, nearly level soils on bottom land. These soils formed under tall prairie grasses and scattered hardwoods in old, medium-textured, silty alluvium that washed from nearby soils on uplands. They occur in all parts of the county.

In a representative profile, the surface layer is very dark grayish-brown, slightly acid silt loam about 7 inches thick. The subsurface layer is mottled, grayish-brown silt loam about 13 inches thick. This layer is strongly acid and has common concretions. The subsoil is mottled, grayish-brown silty clay loam about 28 inches thick. It is friable to firm and strongly acid. Concretions are common. The underlying material is firm, gray silty clay loam that extends to a depth of about 72 inches. It has brownish mottles and is strongly acid.

Hepler soils are low in natural fertility and are somewhat poorly drained. Runoff is slow, permeability is moderately slow, and the available water capacity is high. These soils are seasonally ponded and are occasionally flooded. Because they are wet, their use is limited. If management is specialized, row crops can be grown year after year. The potential for growing irrigated field crops and vegetables on these soils is good, but the availability of an adequate water supply limits the acreage that can be irrigated.

A large part of the acreage is cultivated. Sorghums, small grain, corn, soybeans, grass, and legumes are the principal crops. Most of the remaining acreage is in pasture, brush, and timber.

Representative profile of Hepler silt loam, in a field of lespedeza, 250 feet north and 1,290 feet west of the southeast corner of sec. 4, T. 31 N., R. 29 W.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate, very fine, granular structure; very friable; common roots; common worm channels and casts; few small iron and manganese concretions; slightly acid; abrupt, smooth boundary.

A2—7 to 20 inches, grayish-brown (10YR 5/2) silt loam; few, fine, faint, gray and dark grayish-brown mottles; weak, medium and thin, platy structure; very friable; common woody roots and a few grass roots; common small worm channels and casts; common iron and manganese concretions; strongly acid; gradual, smooth boundary.

B1t—20 to 30 inches, grayish-brown (10YR 5/2) light silty clay loam; few, fine, faint, dark grayish-brown mottles; weak, fine, subangular blocky structure; friable; few, fine, dead, woody roots; thin patchy clay films; few thick black clay films in root channels; few worm channels and casts; common iron and manganese concretions; strongly acid; gradual, smooth boundary.

B2t—30 to 48 inches, grayish-brown (10YR 5/2) silty clay loam; few, fine, faint, dark-brown mottles; weak, fine and medium, subangular blocky structure; firm; thin, patchy, very dark gray and dark-gray clay films; few worm channels; common iron and manganese concretions; strongly acid; gradual, smooth boundary.

C—48 to 72 inches, gray (10YR 5/1) silty clay loam; many, coarse, dark-brown (7.5YR 4/4) mottles; massive; firm, few, thin, patchy, very dark gray clay films; common iron and manganese concretions; strongly acid.

The Ap horizon, or the A1 horizon, is dominantly very dark grayish-brown (10YR 3/2) or dark-brown (10YR 3/3) silt loam about 6 to 10 inches thick. In some places it is very dark gray (10YR 3/1). The A2 horizon ranges from gray (10YR 5/1) to dark grayish brown (10YR 4/2). The A2 horizon of Hepler silt loam, overwash, is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3) beginning at a depth of 6 to 10 inches and extending to a depth of about 18 inches. The combined thickness of all the A horizons is 16 to about 30 inches. In some profiles the B2t and C horizons have distinct, medium or coarse, black concretionary stains. Except where the surface layer has been limed, these soils are strongly acid or very strongly acid. They are 60 to more than 100 inches deep.

Hepler soils are on low stream terraces or in bottoms, where they are associated with soils of the Askew, Cherokee, Lanton, Verdigris, Cleora, and Radley series. They have a darker colored or thicker surface layer than Askew and Cherokee soils, a less clayey subsoil than Cherokee soils, and a thinner dark-colored surface layer than Lanton or Verdigris soils. Hepler soils are finer textured throughout than Cleora soils, and they are grayer, more acid, wetter, and in higher positions than Verdigris or Radley soils.

Hepler silt loam (Hm).—This nearly level soil is on low stream terraces near the larger streams. Most areas are between the uplands and the natural levees of old streams or the current meander belt. They are about 20 acres to more than 100 acres in size and are long, wide, and shaped well for farming. Most areas are cleared and cultivated. A profile of this soil is described as representative for the series.

Included with this soil in mapping is a soil similar to Hepler silt loam, except that its surface layer is light colored or is thinner. This included soil is on the flood plains of Horse Creek and the flood plains of tributaries of the Spring River. It makes up 20 to 30 percent of the mapped areas. Also included are some small areas of Hepler silt loam, overwash, which are adjacent to the meander belt, and areas of Cherokee silt loam, which are on the crest of ridgetops or terraces.

This Hepler soil is wet from seasonal ponding and overflow. The choice of crops is reduced, and special conservation practices are needed. Sorghums, small grain, corn, soybeans, grasses, and legumes are suited crops. A good response to management can be expected. Capability unit IIIw-1.

Hepler silt loam, overwash (Hp).—Most areas of this nearly level soil are on natural levees of old streams or on low terraces at the edge of the meander belt of larger streams. In a few places, areas of this soil extend across relatively narrow flood plains of tributaries. The areas are about 10 acres to more than 50 acres in size and are long and narrow and well shaped for farming. Most of them

are cleared and cultivated. This soil is similar to the one described as representative for the series, except that it has a surface layer of overwash. The combined thickness of the overwash is 6 to 18 inches. The upper 6 to 10 inches is dark brown, and the lower part is brown.

Included with this soil in mapping are areas of Hepler silt loam, which are on the upland side, and areas of Radley and Verdigris silt loams, which are on the stream side. Also included are a few places where the overwash exceeds a thickness of 20 inches. These inclusions together generally make up no more than 20 percent of any mapped area.

A very good response to management can be expected. The overwash improves runoff, drainage, and natural fertility, but this soil is wet from seasonal overflow, and the choice of crops is reduced or moderate conservation practices are required. The soil is suited to corn, sorghums, soybeans, small grain, grasses, and legumes, including alfalfa. Capability unit IIw-1.

Hepler-Radley silt loams (Hr).—This complex consists of nearly level silt loams in the narrow bottoms of upland drainageways. These soils are between the Breaks-Alluvial land complex upstream and the wide flood plains downstream (see fig. 3 p. 4). They are confined to the drainageways and do not occupy the uplands. Areas upstream are mostly long and narrow and are dissected into many parts by intermittent streams. Downstream, the areas are elongated, as much as 900 feet wide, and well shaped for cultivation. They range from 10 acres to more than 80 acres in size.

Hepler silt loam generally makes up about 50 percent of the complex, but its percentage of the total acreage increases where the flood plains are wider. This soil is adjacent to the uplands on one side and to the meander belt on the other side. Radley silt loam makes up about 35 percent of the complex. It is in the meander belt.

Included with this complex in mapping are areas of Verdigris silt loam, Cleora fine sandy loam, and Hepler silt loam, overwash. Verdigris and Cleora soils are in the meander belt. Hepler silt loam, overwash, is on the low terraces at the edge of the meander belt. Each of these soils occur in areas of about the same size. Combined, these inclusions make up about 15 percent of the areas mapped as this complex.

A good response to management can be expected. Seasonal wetness caused by ponding and overflow is the major limitation affecting the use of these soils. It reduces the choice of crops or makes special conservation practices necessary. Upstream, near the Breaks-Alluvial land complex, the soils are suited to grasses, legumes, and trees. Downstream, they are suited to sorghums, small grain, corn, soybeans, grasses, and legumes. Capability unit IIIw-1.

Keeno Series

The Keeno series consists of gently sloping to strongly sloping soils on uplands. These soils contain chert fragments throughout and have a firm fragipan at a depth of 18 to 36 inches. They formed under tall prairie grasses in cherty limestone residuum.

In a representative profile, the surface layer is very dark brown, strongly acid cherty silt loam about 16 inches thick. The subsoil is dark-brown, strongly acid very cherty light silty clay loam about 11 inches thick. The firm fragipan is mottled, brownish and grayish very cherty silt loam about 15 inches thick. It is very strongly to strongly acid. Below the fragipan is coarsely mottled reddish, grayish, and brownish very cherty silty clay that is more than 30 inches thick. It is slightly acid.

Keeno soils are medium in natural fertility and moderately well drained. Runoff is medium. Permeability above the fragipan is rapid, but it is slow in the fragipan. The available water capacity is low. Droughtiness is a limitation that affects use of these soils.

A large acreage of Keeno soils is in native tall prairie grasses, woody shrubs, and brush (fig. 14) and is pastured or mowed for hay. Cultivated areas are mostly in grasses and legumes. A few acres are in small grain, sorghums, corn, and soybeans.

Representative profile of Keeno cherty silt loam, 2 to 9 percent slopes, in a native prairie hayfield, 1,320 feet north and 30 feet west of the southeast corner of sec. 18, T. 31 N., R. 29 W.:

A—0 to 16 inches, very dark brown (10YR and 7.5YR 2/2) cherty silt loam, brown (10YR 5/3) dry; strong, very fine, granular structure; very friable; many roots; thin organic films; many worm channels and casts; 20 percent fragments of chert; strongly acid; gradual, smooth boundary.

Bt—16 to 27 inches, dark-brown (7.5YR 3/2) very cherty light silty clay loam; moderate, very fine, subangular blocky and fine granular structure; friable; common roots; common clay films; many worm channels and casts; about 60 percent fine fragments of chert; strongly acid; clear, wavy boundary.

A'x—27 to 33 inches, coarsely mottled pale-brown (10YR 6/3) and dark grayish-brown (10YR 4/2), very cherty silt loam; lesser amounts of mottled, light brownish-gray (10YR 6/2), strong-brown (7.5YR 5/6), and grayish-brown (10YR 5/2) silt loam; massive; firm and compact in place; brittle when moist; thin patchy clay films; 70 percent fine fragments of chert; few very small iron and manganese concretions; very strongly acid; clear, smooth boundary.

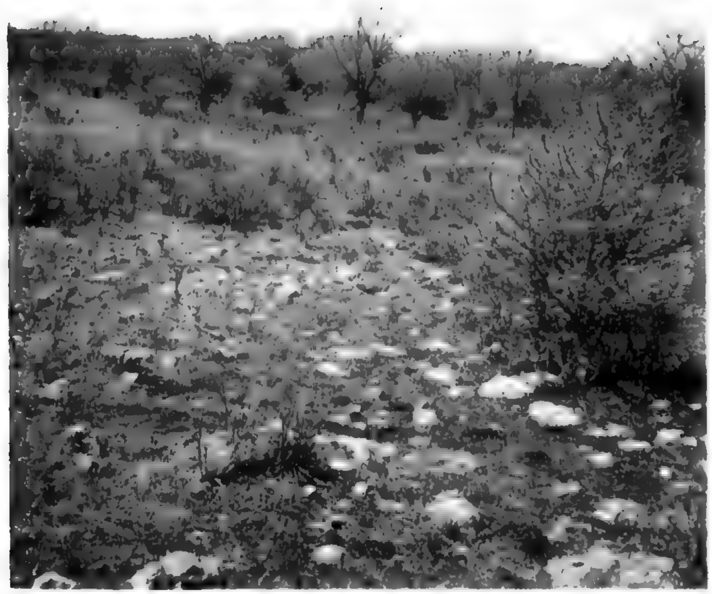

Figure 14.—Keeno stony silt loam, 2 to 9 percent slopes.

B'x—33 to 42 inches, yellowish-brown (10YR 5/6) and very pale brown (10YR 7/3), very cherty silt loam; few, fine, distinct, very dark grayish-brown (10YR 3/2) and dark reddish-brown (5YR 3/4) mottles, and few, fine, faint, light brownish-gray, light gray, pale-brown, and strong-brown mottles; massive; firm and compact in place; brittle when moist; thick patchy clay; few, very small, black concretionary stains or smears; 60 percent fine fragments of chert; strongly acid; clear, wavy boundary.

B2bt—42 to 72 inches, coarsely mottled, red (2.5YR 4/8), gray (N 7/0), light-gray (10YR 7/1), and pale-brown (10YR 6/3) very cherty silty clay; few, fine, faint, dark-red, strong-brown, and yellowish-brown mottles; moderate, very fine, angular blocky structure; very firm; thick continuous clay films; 65 percent fragments of chert; slightly acid.

Depth to bedrock ranges from 6 to about 10 feet. The A horizon ranges from very dark brown (7.5YR 2/2) to dark brown (10YR 3/3). Texture is dominantly cherty silt loam but ranges from silt loam or loam to cherty loam. Content of chert is higher in the lower part of the horizon than it is in the upper part. Except where the surface layer has been limed, reaction is medium acid or strongly acid. The Bt horizon ranges from very dark grayish brown (10YR 3/2) to yellowish red (5YR 4/6), but in some places the lower part of the horizon is redder than the upper part. Mottles are present but do not indicate wetness within the upper 10 inches. The A'x and B'x horizons have platy or subangular blocky structure in some places. The content of chert ranges from 35 to 80 percent. The B2bt horizon is absent in some places, and if so, the B'x horizon directly overlies a C horizon.

Keeno soils are associated with Creldon and Parsons soils. They are also associated with and similar to Nixa and Lebanon soils. They have a darker colored or thicker surface layer than Lebanon and Nixa soils. Keeno soils have more chert in the surface layer and subsoil than Lebanon, Creldon, and Parsons soils.

Keeno cherty silt loam, 2 to 9 percent slopes (KeC).—This cherty soil is on ridgetops, points, and side slopes. Areas are shaped well for farming and are about 5 acres to more than 40 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of a soil that is similar to this Keeno soil, except that it lacks a fragipan. In sloping areas near boundaries and on terminal points of gently sloping ridgetops, this included soil makes up as much as 20 percent of some mapped areas. Also included are areas of Creldon soils and areas of Keeno stony silt loam, 2 to 9 percent slopes. Each of these inclusions makes up as much as 10 percent of the acreage mapped. The Creldon soils are on ridgetops, and the stony Keeno soil is on the side slopes. Combined, all the inclusions generally make up no more than 25 percent of the mapped areas.

A fair response to management can be expected. Because this soil is droughty, the choice of plants is restricted and very careful management is required. The soil is better suited to grasses, legumes, and small grain than to other plants. Many of the gently sloping areas also are suited to sorghums and other row crops grown in rotations that include several years of hay crops. Capability unit IVs-9.

Keeno stony silt loam, 2 to 9 percent slopes (KnC).—This soil is on ridgetops, points, and side slopes. Areas are large in most places but range from about 10 acres to more than 100 acres in size.

This soil has a profile that is similar to the one described as representative for the series, except that stones are on the surface and stones and fragments of chert are in the surface layer. Stones are 10 inches to more than 24 inches in diameter and are less than 5 feet to about 100 feet apart.

Included with this soil in mapping are areas of Keeno cherty silt loam, 2 to 9 percent slopes, that make up as much as 20 percent of many mapped areas. Also included are areas of gently sloping Creldon soils that make up about 10 percent of the mapped areas on ridgetops in some places. Other inclusions are areas of a soil that is similar to this Keeno soil, except that it lacks a fragipan. Altogether, inclusions generally make up no more than 25 percent of any mapped area.

Stones on the surface or in the surface layer make this soil unsuitable for cultivation. Use of farm machinery is impractical. Only small, scattered, nonstony inclusions of other soils can be mowed or worked for hay or pasture crops. The soil is droughty. These severe limitations restrict its use mostly to grazing, woodland, or wildlife habitat. Most of the acreage is in native prairie vegetation and brush. This soil is better suited to grazing and wildlife habitat than to other uses. A poor response to management can be expected. Capability unit VIIs-10.

Lanton Series

The Lanton series consists of deep, nearly level soils on bottom lands. These soils formed in nearly neutral, fine-textured sediment washed from nearby soils on uplands that formed mostly in limestone residuum and partly in other materials.

In a representative profile, the surface layer is very dark gray and black silty clay loam about 12 inches thick. The subsoil is 53 inches thick. The upper 24 inches of the subsoil is very dark gray silty clay loam. The lower 29 inches is dark-gray silty clay loam. The underlying material is gray, firm light silty clay loam.

Lanton soils are high in natural fertility and are poorly drained. Runoff is slow, permeability is slow, and the available water capacity is high. Overflows are occasional or frequent. Wetness is the major limitation that affects use of these soils. If management is specialized, row crops can be grown year after year. The potential for growing irrigated field crops and vegetables on these soils is good, but the availability of an adequate water supply limits the acreage that can be irrigated.

Most areas of these soils are cultivated. Corn, soybeans, sorghums, small grain, grasses, and legumes are grown. A few areas to which access is limited are in brush and timber. The remaining acreage is in permanent pasture.

Representative profile of Lanton silty clay loam, in a cultivated field, 770 feet south and 1,780 feet west of the northeast corner of sec. 5, T. 31 N., R. 29 W.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silty clay loam; weak, fine, granular structure; friable; few dead roots; thin organic films; few very fine pebbles; neutral; abrupt, smooth boundary.

A1—9 to 12 inches, black (10YR 2/1) silty clay loam; moderate, fine, granular structure; friable; thin continuous organic films; few worm channels and casts; few small iron and manganese concretions; few dark yellowish-brown (10YR 4/4) organic stains on ped surfaces; few very fine pebbles; neutral; gradual, smooth boundary.

B21—12 to 36 inches, very dark gray (10YR 3/1) silty clay loam; few, fine, faint, dark-gray and dark yellowish-

brown mottles; weak, fine and very fine, subangular blocky structure; firm; common small iron and manganese concretions; few very fine pebbles; neutral; gradual, smooth boundary.

B22g—36 to 65 inches, dark-gray (5Y 4/1) silty clay loam; common, medium, distinct, dark yellowish-brown mottles and few, fine, faint, gray mottles; weak, very fine and fine, subangular and angular blocky structure; firm; common small iron and manganese concretions; few very fine pebbles; neutral; gradual, smooth boundary.

Cr—65 to 72 inches, gray (5Y 5/1) light silty clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles and few, fine, faint, dark-gray mottles; massive; firm; common iron and manganese concretions; few fine pebbles less than ¼ inch in diameter and less than 10 percent by volume; neutral.

The A horizon is black (10YR 2/1) to very dark grayish brown (10YR 3/2) silty clay loam or silt loam and is 10 to 30 inches thick. The upper part of the B horizon ranges from black (10YR 2/1) to very dark gray (2.5Y 3/1), and the lower part from dark gray (10YR 4/1) to light gray (5Y 6/1). Thickness ranges from 15 to 60 inches. Texture is silty clay loam in the upper part of the horizon and silty clay loam to clay in the lower part. Content of gravel is generally less than 5 percent but at a depth of 40 inches or more ranges to as much as about 35 percent. Lanton soils are dominantly nearly neutral, but in some areas of overwash, they range to medium acid.

Lanton soils are on wide flood plains of large streams and in some upland drainageways. They are near soils of the Summit, Hepler, Radley, and Verdigris series. A thicker, dark-colored surface layer distinguishes them from Summit, Hepler, and Radley soils. A coarser textured 10- to 40-inch zone also distinguishes them from Summit soils. The underlying material in Lanton soils is finer textured, grayer, and wetter than it is in Radley and Verdigris soils.

Lanton silty clay loam (La).—This nearly level soil is on flood plains. Areas are about 10 acres to more than 40 acres in size. They are long and narrow in upland drainageways. A profile of this soil is described as representative for the series.

Included with this soil in mapping are a few small areas of Lanton and Verdigris silt loams; Summit silty clay loam, 0 to 2 percent slopes; and Hepler silt loam. Also included are areas of a soil that is similar to this Lanton soil, except that it has a clayey surface layer and subsoil. This included soil is in a few small areas of the bottom land south of Golden City. These inclusions together generally make up no more than 20 percent of the mapped areas.

A good response to management can be expected. Seasonal wetness caused by ponding and overflow is the major limitation affecting the use of this soil. The choice of crops is reduced, or moderate conservation practices are required. The soil is suited to corn, sorghum, soybeans, small grain, grass, and legume crops. Crops that tolerate some wetness are better suited to this soil than those that do not. Capability unit IIw–1.

Lanton and Verdigris silt loams (Ld).—This mapping unit consists of nearly level Lanton and Verdigris soils. The proportionate extent and location of these undifferentiated soils varies from one mapped area to another. The acreage of the poorly drained Lanton soil is twice that of the well-drained Verdigris soil in the lower reaches, and it is six times that of the Verdigris soil in the upper reaches. Showing the two soils separately on the soil map is not practical. Areas of the mapping unit are less than 40 acres to more than 100 acres in size. They are long and narrow and are divided by many stream channels. The Lanton soil has a profile similar to the one described as representative for the series, except that the surface layer is thicker in most places, most commonly it is very dark grayish brown, the upper 24 inches of the subsoil has more silt and less clay, and gravel is more plentiful in the lower part of the subsoil and the underlying material.

Included with this unit in mapping are a few small areas of Lanton silty clay loam. Also included are a few small scattered areas of Summit silty clay loam, 0 to 2 percent slopes.

Response to management is good or very good. Seasonal wetness caused by ponding and overflow is the major limitation affecting the use of these soils. The choice of crops is reduced, or moderate conservation practices are required. These soils are suited to corn, sorghums, soybeans, small grain, grass, legumes, and walnut trees. Crops that tolerate some wetness are better suited to the soils than those that do not. Capability unit IIw–1.

Lebanon Series

The Lebanon series consists of deep, gently sloping soils on uplands. These soils have a firm fragipan at a depth of 18 to 36 inches (fig. 15). They formed under trees in cherty limestone residuum that has a thin mantle of loess or old silty alluvium.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 2 inches thick. The subsurface layer is grayish-brown and brown silt loam about 4 inches thick. The subsoil extends to a depth of 72 inches or more. The upper 4 inches of the subsoil is strong-brown silty clay loam, the next 7 inches is reddish-brown silty clay loam, and the next 5 inches is mottled grayish-brown, yellowish-brown, and strong-brown silty clay loam. The fragipan is mottled, grayish, brownish, and reddish very cherty silty clay loam about 16 inches thick. Below this is mottled, yellowish, grayish, brownish, and reddish cherty silty clay to clay.

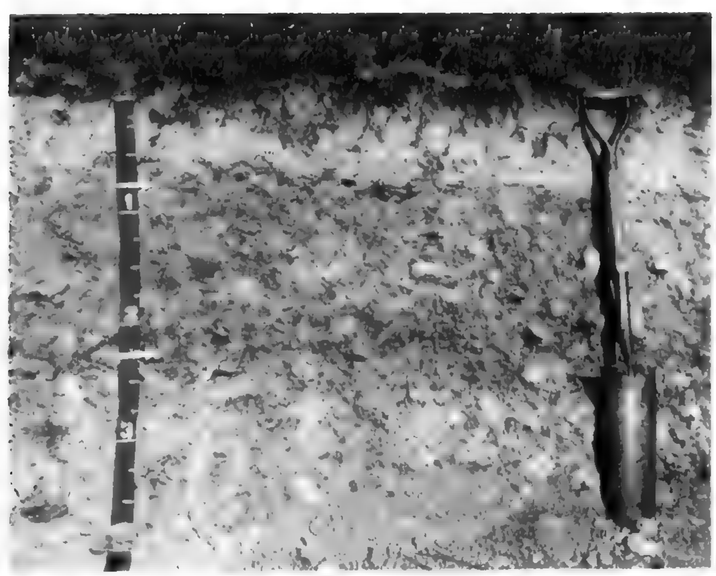

Figure 15.—**Profile of Lebanon silt loam, 2 to 5 percent slopes.**

Lebanon soils are low in natural fertility and are moderately well drained. Runoff is medium. Permeability above the fragipan is moderate, but it is slow in the fragipan. Available water capacity is moderate. A fragipan at a moderate depth makes these soils somewhat droughty. Susceptibility to erosion, however, is the major limitation that affects their use.

More than half the acreage of these soils is in grasses and legumes that are used for pasture and hay. A large acreage is in stands of post oak and brush. A few acres are in small grain and sorghums.

Representative profile of Lebanon silt loam, 2 to 5 percent slopes, in an area of post oak sprouts and a few wild grasses, 600 feet north and 425 feet west of the southeast corner of sec. 16, T. 31 N., R. 29 W.:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; strong, very fine, granular structure; very friable; many grass roots and woody roots; few worm channels and casts; few very small iron and manganese concretions; strongly acid; abrupt, smooth boundary.

A2—2 to 6 inches, grayish-brown (10YR 5/2) and brown (10YR 5/3) silt loam; light gray (10YR 7/2) and very dark brown (10YR 7/3) dry; few, faint, very dark grayish-brown and yellowish-brown mottles; moderate, thin, platy structure; very friable; common woody roots; vesicular; common worm channels; common worm casts; few iron and manganese concretions; very strongly acid; clear, wavy boundary.

B1t—6 to 10 inches, strong-brown (7.5YR 5/6) light silty clay loam; many, fine, faint, pale-brown mottles; weak, very fine, subangular blocky structure; very friable; common woody roots; thin patchy clay films; common worm channels and a few casts; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

B21t—10 to 17 inches, reddish-brown (5YR 4/4) silty clay loam; many, fine, faint, yellowish-red mottles and few, fine, faint, brown mottles; strong, fine and medium, angular and subangular blocky structure; firm; few roots; thin continuous clay films; few worm channels; common very small iron and manganese concretions; extremely acid; clear, smooth boundary.

B22t—17 to 22 inches, mottled, grayish-brown (10YR 5/2), yellowish-brown (10YR 5/4), and strong-brown (7.5YR 5/6) silty clay loam; few, medium, distinct, yellowish-red (5YR 4/6) and dark-red (2.5YR 3/6) mottles and few, fine, faint, dark-gray mottles; moderate, fine and medium, angular and subangular blocky structure; firm; few roots; thin continuous clay films; few worm channels; common very small iron and manganese concretions; extremely acid; clear, wavy boundary.

IIBx1—22 to 29 inches, coarsely mottled grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) very cherty silty clay loam; lesser amounts of gray (10YR 6/1 and 5/1), dark-gray (10YR 4/1), brownish-yellow (10YR 6/6), and yellowish-red (5YR 5/8) silty clay loam; massive; firm; hard, compact and brittle; few roots; thick patchy clay films; few iron and manganese concretions; common, discontinuous, horizontal clay seams; about 65 percent chert; extremely acid; clear, wavy boundary.

IIBx2—29 to 38 inches, dark-red (2.5YR 3/6) and red (2.5YR 4/8) very cherty silty clay loam; few, fine, distinct, grayish-brown mottles and few, fine, faint, yellowish-brown and brownish-yellow mottles; massive; firm; hard, compact and brittle; few roots; thick patchy clay films; few iron and manganese concretions; common dark-gray clay seams and pockets; very strongly acid; clear, wavy boundary.

IIB23t—38 to 53 inches, red (2.5YR 4/8) and brownish-yellow (10YR 6/6) cherty silty clay; few, fine, faint, dark-gray, yellowish-brown, and yellowish-red mottles; moderate, medium and coarse, angular blocky structure; very firm; few roots; few iron and manganese concretions; about 40 percent chert; very strongly acid; clear, wavy boundary.

IIB24t—53 to 72 inches, brownish-yellow (10YR 6/6) and yellowish-red (5YR 5/8) clay; few, fine, faint, strong-brown and dark-gray mottles; moderate, medium and coarse, angular blocky structure; very firm; few roots; few iron and manganese concretions; common calcium concretions; about 10 percent chert; slightly acid.

The Ap horizon and the A2 horizon are dominantly brown (10YR 5/3 and 4/3) but range to grayish brown (10YR 5/2). In undisturbed areas an A1 horizon that is dark brown (10YR 3/3) to very dark brown (10YR 2/2) and about 1 to 4 inches thick is present. In most places the A horizon contains few fragments of chert. The B horizon ranges from medium acid to extremely acid in reaction and from about 14 to 26 inches in thickness. The B1t horizon is brown (10YR 4/3) to strong brown (7.5YR 5/6) in color and from 3 to 8 inches in thickness. The B21t horizon ranges from yellowish brown (10YR 5/4) to reddish brown (5YR 4/4) or yellowish red (5YR 5/6). The B22 horizon, in most places, is mottled and the dominant color is not redder than 7.5YR. The B2t horizon ranges from silty clay loam in the upper part to heavy silty clay loam, light silty clay, or cherty silty clay loam in the lower part. The IIBx1 and IIBx2 horizons range from strongly acid to extremely acid and are 8 to 40 inches thick. Low, slightly concave slopes have less than 15 percent fragments of chert in places. The horizons below the fragipan range from very strongly acid to slightly acid and contain a little less than 15 percent to more than 36 percent fragments of chert.

Lebanon soils are associated with Creldon, Keeno, Nixa, and Askew soils. They have a lighter colored or thinner surface layer than Creldon and Keeno soils. They have less chert in the surface layer and subsoil than Keeno and Nixa soils. Lebanon soils, unlike Askew soils, have a fragipan and at least a few fragments of chert throughout the soil.

Lebanon silt loam, 2 to 5 percent slopes (LeB).—This soil is on ridgetops, side slopes and foot slopes (see fig. 7, p. 11). Areas are smooth and well shaped. Most of them are more than 40 acres in size.

Included with this soil in mapping are areas of a soil that is similar to this Lebanon soil, except that it has grayish mottles in the upper 10 inches of the subsoil. This included soil is on the crest of ridgetops and on slightly concave side slopes and foot slopes. It makes up as much as 25 percent of some mapped areas. Also included are areas of eroded Lebanon soils on cultivated side slopes and foot slopes near the heads of drainageways. These included soils make up 10 to 20 percent of the acreage mapped. Other inclusions are scattered spots of Lebanon and Nixa soils that have a cherty silt loam surface layer or have slopes of more than 5 percent, or have both. The combined acreage of the inclusions is generally no more than 25 percent of the areas mapped.

The response to management is good. Susceptibility to erosion and droughtiness are limitations affecting use of this soil. The choice of plants is reduced or special conservation practices are required, or both. The soil is suited to small grain, sorghums, grasses, legumes, corn, and soybeans. Capability unit IIIe-5.

Liberal Series

The Liberal series consists of gently sloping to strongly sloping soils on uplands. These soils are underlain by shale at a depth of 40 to 60 inches. They formed under tall prairie grasses in shale residuum. In many places

the shale is interbedded with thin layers of sandstone, and in most places a few fragments of sandstone are on the surface and throughout the soils. Some fragments are coated with iron compounds.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsoil is about 24 inches thick. The upper 9 inches is brown silty clay loam, the next 6 inches is brown silty clay, and the lower 9 inches is mottled olive gray clay. The surface layer and the subsoil are very strongly acid. The underlying material is coarsely mottled gray clay that grades to gray, strongly acid, stratified shale.

Liberal soils are medium in natural fertility and are moderately well drained. Runoff is medium to rapid, and permeability is slow. Available water capacity is moderate or low. Susceptibility to erosion is the major limitation that affects use of these soils, and the depth to shale tends to make the soils wet or dry, depending on the season.

More than half the acreage is in native tall prairie grasses or tame grasses that are used for hay or pasture. Most of the remaining acreage is cultivated. The principal crops are wheat, sorghums, grasses, legumes, corn, and soybeans.

Representative profile of Liberal silt loam, 2 to 6 percent slopes, in a native prairie hayfield, 155 feet south and 1,960 feet east of the northwest corner of sec. 34, T. 33 N., R. 33 W.:

A1—0 to 7 inches, very dark grayish-brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) dry; moderate, very fine, granular structure; friable; many roots; many worm channels and casts; common iron and manganese concretions; few fragments of sandstone on the surface and throughout the horizon; very strongly acid; clear, smooth boundary.

B1t—7 to 11 inches, brown (10YR 4/3) silty clay loam; moderate, very fine, subangular blocky structure; friable; many roots; thin patchy clay films; common worm channels and very dark grayish-brown casts; common iron and manganese concretions; few large iron concretions and fragments of sandstone at the lower boundary; very strongly acid; clear, smooth boundary.

B21t—11 to 16 inches, brown (10YR 4/3) silty clay loam; few, fine, faint, yellowish-brown, dark yellowish-brown, and strong-brown mottles; moderate, very fine, subangular blocky structure; firm; common roots; thin patchy clay films; common worm channels and casts; many iron and manganese concretions; very strongly acid; clear, smooth boundary.

B22t—16 to 22 inches, brown (10YR 5/3) silty clay; common, fine, distinct, yellowish-red mottles; common, coarse, faint, yellowish-brown (10YR 5/6) mottles and few, fine, faint, grayish-brown mottles; moderate, fine, angular blocky structure; very firm; few roots; thick continuous clay films; few worm channels and casts; common iron and manganese concretions; very strongly acid; clear, smooth boundary.

B3t—22 to 31 inches, coarsely mottled olive-gray (5Y 5/2), light olive-gray (5Y 6/2), and gray (5Y 6/1) clay; many, coarse, prominent, red (2.5YR 4/8) and dark-red (2.5YR 3/6) mottles and few, fine, distinct, strong-brown mottles; weak, coarse, angular blocky structure; very firm; few roots; thick continuous clay films on pressure faces; few iron and manganese concretions; few iron concretions near the lower boundary; very strongly acid; clear, smooth boundary.

C—31 to 43 inches, gray (5Y 6/1) clay; common, coarse, prominent, red (2.5Y 4/6) mottles; massive; very firm; few roots; few iron and manganese concretions; very strongly acid; clear, smooth boundary.

R—43 to 72 inches, gray (5Y 5/1) clay shale thinly interbedded with brown and brownish-yellow sandstone; stratified; strongly acid.

The A1 horizon, or the Ap horizon, is dominantly heavy silt loam but ranges from loam to silty clay loam or clay loam. It ranges from 6 to 10 inches in thickness and is medium acid to very strongly acid. The Bt horizon is medium acid to extremely acid. The B1t horizon ranges from brown (7.5YR 4/4) to light olive brown (2.5Y 5/4). The B2t horizon is similar to the B1t in color but ranges to lighter colors and includes grayish mottles at a depth greater than 10 inches below the top of the B1t horizon. The B2t horizon is silty clay to clay. The B3t and C horizons have a wide range of color. Medium or coarse, prominent, red mottles are common. Texture is silty clay loam, silty clay, or clay. The C horizon is medium acid to extremely acid.

Liberal soils are associated with Barco, Collinsville, Bolivar, Bronaugh, Barden, and Parsons soils. They are not so deep as Bronaugh, Barden, and Parsons soils and are finer textured than Barco, Collinsville, and Bolivar soils. They are deeper to bedrock than Collinsville soils and have a darker colored or thicker surface layer than Bolivar soils.

Liberal silt loam, 2 to 6 percent slopes (LlB).—This soil is on knobs, ridgetops, side slopes, and foot slopes in areas less than 5 acres to more than 50 acres in size. Slopes are convex. A profile of this soil is described as representative for the series.

Included with this soil in mapping are areas of Barden silt loam, 1 to 4 percent slopes, that make up about 15 percent of the acreage mapped. Also included are small, scattered areas of Parsons, Barco, Collinsville and eroded Liberal soils. Together these soils make up about 5 to 15 percent of many mapped areas. The Barden soil is on foot slopes or in saddles that cross the ridgetops, the Parsons soil is on the crest of the wider ridgetops, and Collinsville and Barco soils are on the high part of knobs. The Collinsville soil also is on breaks, and the Barco soil also is in narrow rims above or below the breaks.

This Liberal soil has moderate available water capacity. A good response to management can be expected. The soil is susceptible to erosion and is seasonally wet or dry. These limitations reduce the choice of plants and require special conservation practices. Grasses, legumes, and small grain are well suited, and sorghum and other row crops can be safely grown in rotations that include hay and pasture crops. Capability unit IIIe–5.

Liberal silty clay loam, 2 to 9 percent slopes, eroded (LmC2).—This soil is near the slope break on knobs, ridgetops, points, side slopes, and foot slopes. It has a profile similar to the one described as representative for the series, except that erosion has scarred the landscape and reduced the surface layer to about 6 inches of very dark grayish-brown silty clay loam. The present surface layer is a mixture of the remaining original surface layer and a small amount of subsoil material. Many erosion scars and gullies expose the lighter, brighter colored, fine-textured subsoil in many places.

Included with this soil in mapping are areas of severely eroded or gullied soils and lesser amounts of uneroded Liberal soils. These inclusions make up about 25 percent of many areas mapped as this Liberal soil. Also included are small areas of Collinsville, Barco, Barden, and Parsons soils and a few small areas of wet soils. These inclusions together make up about 10 percent of some mapped areas. The wet soils are poorly drained and have a grayish subsoil. The uneroded Liberal and Parsons soils are on the ridgetops, the Collinsville soils are on breaks, and Barco soils are in narrow bands above or

below the breaks. Barden soils and the wet soils are on foot slopes or in saddles that cross the ridgetops.

This Liberal soil is low in available water capacity. A fair response to management can be expected. Because this soil is susceptible to further erosion and to drought, the choice of crops is severely restricted and careful management is required. The soil is suited to grasses, legumes, and small grain, and an occasional sorghum crop can be safely grown in long rotations that include hay or pasture crops. Capability unit IVe-7.

Liberal, Collinsville and Barco soils, 2 to 14 percent slopes (LoD).—This mapping unit consists of undifferentiated soils on mounds and on relatively narrow ridgetops, points, and sides of low divides (see fig. 2, p. 3). It is made up of about equal parts of Liberal, Collinsville, and Barco soils that are intermingled in such intricate patterns that it is not practical to separate them. These soils formed in alternating beds of shale and sandstone. The Liberal soils formed mostly in material weathered from shale, and Collinsville and Barco soils formed in material weathered from sandstone. Areas of this mapping unit are about 10 acres to more than 500 acres in size.

Included with these soils in mapping are small areas of Barden and Summit soils. These included soils are in narrow bands adjacent to the lower boundary of areas mapped as this unit. Barden soils also are in saddles that cross ridgetops. Also included are Hepler-Radley silt loams in narrow areas of bottom land.

Soils in this unit are droughty, and some areas are stony. Susceptibility to erosion, however, is the major limitation affecting use of the soils. The response to management is only fair. A large part of the acreage is generally unsuited to cultivation. Here, native prairie grasses and a small acreage of tame grasses provide the needed protective cover. Some areas are too stony to be mowed. A much smaller acreage is cultivated. This acreage is suited to small grains, grasses, and legumes and, to a lesser degree, sorghums, corn, and soybeans. Capability unit VIe-7.

Mine Pits and Dumps

Mine pits and dumps (Mp) consists of narrow, elongated, small to large pits and steep, irregularly shaped dumps. Most of the larger pits are filled with water. The dumps are a mixture of shale, sandstone, and the original mantle of soil stripped from coalbeds.

Included in mapping are areas of Parsons, Barden, Liberal, Collinsville, and Barco soils that make up about 18 percent of the acreage in areas mapped as this land type.

Steep slopes, a litter of large sandstones on the surface, and numerous pits and gullies make tillage of this land type impractical. Natural drainage ranges from poor to excessive, permeability is slow or very slow, and available water capacity is low. The response to management is poor. Runoff is rapid, and the scanty cover of brush, weeds, trees, and grasses offers little protection from erosion. Erosion is very severe and will continue if protective cover is not maintained.

The use of Mine pits and dumps is restricted largely to grazing, woodland, wildlife, and recreation. The land is better suited to these purposes than to other uses. The small, scattered areas of included soils are better suited to grazing than to most other uses. Capability unit VIIe-7.

Newtonia Series

The Newtonia series consists of deep, gently sloping soils on uplands. These soils formed under tall prairie grasses in limestone residuum that has a thin mantle of loess or old silty alluvium.

In a representative profile, the surface layer is dark-brown silt loam about 10 inches thick. The subsoil extends to a depth of 72 inches or more. The upper 5 inches is dark-brown silt loam, the next 5 inches is reddish-brown silty clay loam, the next 20 inches is yellowish-red silty clay loam, and the next 8 inches is red silty clay. The lower 24 inches of the subsoil is firm, dark-red cherty silty clay that is strongly acid.

Newtonia soils are medium in natural fertility and are well drained. Runoff is slow, permeability is moderate, and the available water capacity is high. Susceptibility to erosion is the major limitation that affects use of these soils.

Most areas of these soils are in corn, wheat, sorghums, and soybeans. A small acreage is in grasses, alfalfa, and other legumes that are used for pasture and hay.

Representative profile of Newtonia silt loam, 1 to 3 percent slopes, in a cultivated field, 65 feet north and 2,255 feet east of the southwest corner of sec. 35, T. 31 N., R. 29 W.:

Ap—0 to 10 inches, dark-brown (7.5YR 3/2) silt loam; moderate, very fine, granular structure; very friable; few roots; common worm channels and casts; medium acid; clear, smooth boundary.

B1t—10 to 15 inches, dark-brown (7.5YR 3/2) silt loam; few, fine, faint, dark-brown mottles; strong, fine, granular and weak, very fine, subangular blocky structure; friable; few roots; thin patchy clay films; many worm channels and casts; medium acid; gradual, smooth boundary.

B21t—15 to 20 inches, reddish-brown (5YR 4/4) silty clay loam; few, fine, faint, dark-brown mottles; moderate, very fine, subangular blocky structure; friable; few roots; thin clay films; common worm channels and casts; few iron and manganese concretions; medium acid; gradual, smooth boundary.

B22t—20 to 40 inches, yellowish-red (5YR 4/6) silty clay loam; few, fine, faint, red, dusky red, and dark-brown mottles; strong, very fine, subangular blocky structure; firm; few roots; thin clay films; common worm channels and casts; common iron and manganese concretions, and medium and large splotches of black, manganese concretionary material; few fine fragments of chert; very strongly acid; gradual, smooth boundary.

B23t—40 to 48 inches, red (2.5YR 4/6) silty clay; common, medium, faint, light yellowish-brown (10YR 6/4) mottles; moderate, very fine, angular blocky structure; very firm; thin patchy clay films; common manganese concretions; few fine fragments of chert; very strongly acid; gradual, smooth boundary.

B3t—48 to 72 inches, dark-red (2.5YR 3/6) cherty silty clay; few, fine, distinct, light-brown mottles; moderate, very fine, angular blocky structure; very firm; thin patchy clay films; common manganese concretions; about 25 percent fragments of chert, mostly greater than 3 inches in diameter; very strongly acid.

The A1 horizon, or the Ap horizon, ranges from dark reddish brown (5YR 3/3) to very dark brown (10YR 2/2). It ranges from slightly acid to strongly acid in reaction and from 10 to 18 inches in thickness. The surface layer contains

a few fragments of chert. The B horizon ranges from slightly acid to strongly acid. The B1t horizon ranges from dark brown (7.5YR 3/2) to yellowish red (5YR 5/6). This layer has a mottled effect because of worm activity. The B2t horizon ranges from reddish brown (5YR 5/3) to dark red (2.5YR 3/6). Dominant dark-red colors are present in the B3t horizon. In some places the lower part of the B2t horizon and the B3t horizon are heavy silty clay loam.

Newtonia soils are associated with Creldon, Parsons, and Summit soils. They are redder in the surface layer and subsoil than the associated soils. They have a less clayey subsoil than Bronaugh soils, which have a similar profile. Newtonia soils lack the fragipan that is present in the similar Creldon soils.

Newtonia silt loam, 1 to 3 percent slopes (NeB).—This soil is on low, wide ridgetops and points. Areas are either small and circular or are large, long, and relatively wide. They are few in number and range from about 5 acres to more than 50 acres in size.

Included with this soil in mapping are areas of Creldon soils that make up about 10 percent of the acreage mapped. Also included are small scattered areas or spots of eroded Newtonia soils. The Creldon soils are in narrow bands near the boundaries of mapped areas, and the eroded Newtonia soils are near the slope break at the heads of drainageways.

A very good response to management can be expected. Because this soil is susceptible to erosion, the choice of crops is reduced or moderate conservation practices are required. The soil is well suited to corn, sorghums, small grain, soybeans, grasses, and legumes. It is especially well suited to alfalfa and has a good potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIe-1.

Nixa Series

The Nixa series consists of deep, nearly level to strongly sloping soils on uplands. These soils contain chert throughout and have a firm fragipan at a depth of 18 to 36 inches (fig. 16). They formed under trees in cherty limestone residuum (see fig. 7, p. 11).

In a representative profile, the surface layer is dark-brown, strongly acid cherty silt loam about 4 inches thick. The subsurface layer is brown very cherty silt loam about 9 inches thick. The next layer is brown very cherty heavy silt loam about 16 inches thick. It is very strongly acid. Below this is a firm, mottled, brownish and grayish very cherty silt loam fragipan about 23 inches thick. It is extremely acid. Below this, the subsoil is mottled reddish, yellowish, and grayish cherty silty clay loam, that is more than 20 inches thick. It is firm and very strongly acid.

Nixa soils are low in natural fertility and are moderately well drained. Runoff is medium. Permeability above the fragipan is moderate, but it is slow in the fragipan. The available water capacity is low. Droughtiness, caused by a high concentration of coarse fragments throughout the soil and by moderate depth to the fragipan, limits the use of these soils.

A major part of the acreage is in stands of post oak or brush. The remaining acreage is mostly in grasses and legumes that are used for permanent pasture. A few acres are in small grain, hay, and sorghums.

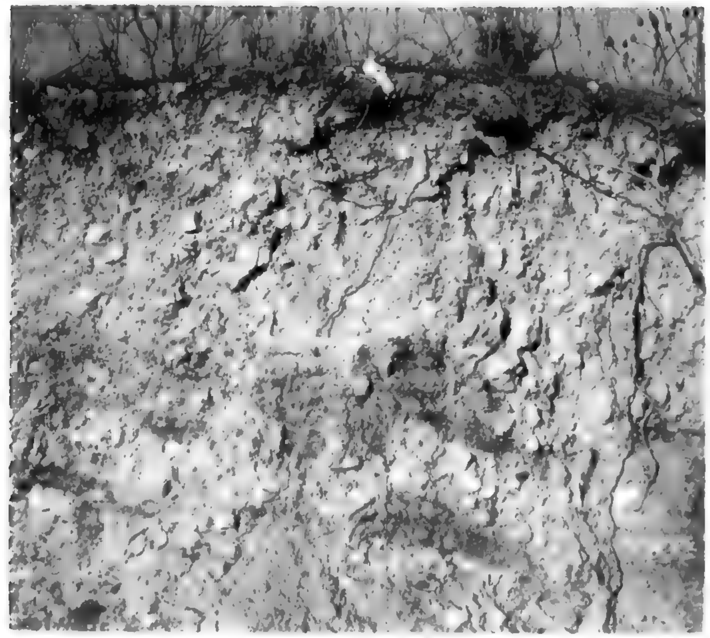

Figure 16.—A deep cut in Nixa cherty silt loam, 2 to 9 percent slopes.

Representative profile of Nixa cherty silt loam, 2 to 9 percent slopes, in an area of short oak trees, 350 feet north and 1,320 feet west of the southeast corner of sec. 5, T. 31 N., R. 29 W.:

A1—0 to 4 inches, dark-brown (10YR 4/3) cherty silt loam, pale brown (10YR 6/3) dry; moderate, very fine, granular structure; very friable; common roots; about 35 percent fragments of chert; strongly acid; clear, smooth boundary.

A2—4 to 13 inches, brown (10YR 5/3) very cherty silt loam; moderate, very fine, granular structure; very friable; common roots; vesicular; about 50 percent fragments of chert; very strongly acid; clear, smooth boundary.

Bt—13 to 29 inches, brown (7.5YR 5/4) very cherty silt loam; pale-brown (10YR 6/3) silt coatings around fragments of chert; weak, very fine, subangular blocky structure; friable; common roots; vesicular; about 70 percent fragments of chert; very strongly acid; clear, smooth boundary.

A'x—29 to 44 inches, mottled, pale-brown (10YR 6/3), light yellowish-brown (10YR 6/4), strong-brown (7.5YR 5/6), and light-gray (10YR 7/2) very cherty silt loam; moderate, thin, platy structure and weak, very fine, subangular blocky structure; firm; thin patchy clay films; about 70 percent fragments of chert; extremely acid; clear, smooth boundary.

B'x—44 to 52 inches, mottled, yellowish-brown (10YR 5/6), strong-brown (7.5YR 5/6), and light-gray (10YR 7/2) very cherty loam; weak, very fine, subangular blocky structure; firm; dark reddish-brown clay flows in interstices, and thick patchy clay films around fragments of chert; about 40 percent fragments of chert; extremely acid; clear, smooth boundary.

B2tb—52 to 72 inches, mottled, red (2.5YR 4/6), dark-red (2.5YR 3/6), reddish-yellow (5YR 6/6), and light-gray (10YR 7/2) cherty silty clay loam; moderate, fine and very fine, subangular blocky structure; firm; about 30 percent fragments of chert; very strongly acid.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to light yellowish brown (10YR 6/4) and is cherty silt loam to loam or their very cherty counterparts. The A1 horizon, where present, ranges from very dark grayish brown

(10YR 3/2) to brown (10YR 4/3) and is 1 to 4 inches thick. The Bt horizon ranges from yellowish brown (10YR 5/6) to yellowish red (5YR 4/6), and in some places the lower part of the horizon is redder than the upper part. Texture ranges from very cherty heavy loam to very cherty silty clay loam. The B2tb horizon is absent in some places, and if so, the B'x horizon directly overlies a C horizon. Depth to bedrock ranges from 6 feet to more than 10 feet.

These soils have a higher base saturation than is within the defined range for the series; however, this does not alter their usefulness or behavior.

Nixa soils are associated with Lebanon, Keeno, and Creldon soils. They have a lighter colored or thinner surface layer than the Keeno and Creldon soils. They have more chert in the surface layer and subsoil than Lebanon soils.

Nixa cherty silt loam, 2 to 9 percent slopes (NhC).—This soil is on narrow ridgetops, points, and side slopes. Areas are few, large, and longer than they are wide.

Included with this soil in mapping are areas of a soil that is similar to Nixa soils, except that it lacks a fragipan. This included soil is on the somewhat steeper slopes near the lower boundary of mapped areas and on narrow terminal points of ridgetops. It makes up as much as 25 percent of some of these areas. Also included are areas of gently sloping Lebanon soils on ridgetops, which make up about 20 percent of some mapped areas. Other inclusions are small areas of a soil that has slopes of more than 9 percent. The combined acreage of the inclusions is generally no more than 25 percent of any mapped area.

A fair response to management can be expected. Droughtiness and, to a lesser degree, very cherty or stony spots are the major limitations affecting use of this soil. The soil is generally unsuitable for cultivation. Its use is limited mostly to pasture, woodland, or wildlife habitat. It is better suited to close-growing grasses and legumes than to other plants. Where it is gently sloping, the soil also is suited to small grain and an occasional sorghum crop grown in long rotations that include several years of pasture or meadow crops. In addition, the soil is suited to woodland. Improved pasture and meadow are potential uses. Capability unit VIs-9.

Parsons Series

The Parsons series consists of deep, level to gently sloping soils on upland divides and benches in all parts of the county. These soils formed under tall prairie grasses in shale residuum overlain by a thin mantle of loess or old silty alluvium. The material in the southeastern part of the county also includes cherty limestone residuum (fig. 17).

In a representative profile, the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is dark grayish-brown silt loam about 6 inches thick. The subsoil is about 34 inches thick. The upper 5 inches is very dark grayish-brown clay, the next 7 inches is dark yellowish-brown clay, the next 22 inches is mottled, brownish-gray, yellowish-brown, and dark yellowish-brown silty clay loam. Many prominent dark-red mottles are in the upper part. The underlying material is mottled, brownish and grayish silty clay loam several feet thick. It is friable, is medium acid, and grades with depth to weathered clayey shale.

Parsons soils are medium in natural fertility and are somewhat poorly drained. Permeability is very slow, and

Figure 17.—Profile of Parsons silt loam, 0 to 1 percent slopes. There is an abrupt change from the light-colored silt loam subsurface layer to the dark-colored clay subsoil.

the available water capacity is high or moderate. A perched water table is at the top of the clay subsoil in wet periods. Susceptibility to erosion, seasonal droughtiness, and wetness are limitations that affect use of these soils.

Most areas of these soils are in row crops and small grain. They are worked with big farm machinery, and the crops marketed as cash-grain crops. The most important crops are corn, wheat, soybeans, and grain sorghums. A small acreage of tame grasses and legumes, mostly tall fescue and lespedeza, is used for hay and pasture. Some redtop is grown for seed. A small and diminishing acreage is in native tall prairie grasses that are mowed for hay.

Representative profile of Parsons silt loam, 0 to 1 percent slopes, in a cultivated field, 650 feet east and 2,595 feet north of the southwest corner of sec. 33, T. 32 N., R. 32 W.:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, fine and medium, platy structure; very friable; few roots; vesicular; few worm channels; medium acid; abrupt, smooth boundary.

A2—8 to 14 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, faint, dark-brown mottles; weak, fine, platy structure; friable; few roots; vesicular; common worm channels; many iron and manganese concretions; very strongly acid; abrupt, wavy boundary.

B21t—14 to 19 inches, very dark grayish-brown (10YR 3/2) clay, brown (10YR 4/3) kneaded; common, medium, distinct, very dark gray (10YR 3/1) mottles and many, fine, prominent, dark-red mottles; weak, coarse, prismatic structure parting to moderate, very fine, angular, blocky structure; very firm; continuous thick clay films; common, dark grayish-brown silty peds in the uppermost inch of this layer; many iron and manganese concretions; very strongly acid; clear, smooth boundary.

B22t—19 to 26 inches, dark yellowish-brown (10YR 4/4) clay; common, medium, distinct, very dark grayish-brown (10YR 3/2) mottles and few, fine, faint, very dark gray and yellowish-brown mottles; weak, coarse, prismatic structure parting to weak, fine, angular blocky structure; very firm; thick continuous clay films; few worm and root channels; many iron and manganese concretions; strongly acid; clear, smooth boundary.

B31t—26 to 39 inches, coarsely mottled, grayish-brown (10YR 5/2), dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/6), and strong-brown (7.5YR 5/6) silty clay loam; weak, coarse, subangular blocky structure; firm; thin patchy clay films on faces of peds; thick clay films in pores and root channels; strongly acid; gradual, smooth boundary.

B32t—39 to 48 inches, coarsely mottled, light-gray (10YR 6/1), dark yellowish-brown (10YR 4/4), and yellowish-brown (10YR 5/6) silty clay loam; weak, coarse, subangular blocky structure; friable; vesicular; thin gray clay films in root channels and pores; strongly acid; gradual, smooth boundary.

C1—48 to 69 inches, strong-brown (7.5YR 5/6) silty clay loam; coarse, medium, prominent, light-gray and gray (10YR 6/1 and 5/1) mottles; massive; friable; medium acid; gradual, smooth boundary.

C2—69 to 92 inches, strong-brown (7.5YR 5/8) clay loam; few, coarse, prominent, light-gray (5Y 6/1) mottles, and few, fine, faint, yellowish-red mottles; massive; few, flat, iron-filled sandstone chips; medium acid.

The A1 horizon, or the Ap horizon, is very dark grayish-brown silt loam 6 to 10 inches thick. In some places the A2 horizon is absent because of erosion or the mixing that results from deep plowing. In undisturbed areas the A1 horizon has strong granular structure in the upper 4 inches. Thickness of the A horizon is 6 to 16 inches. The B2t horizon ranges from 10 to 16 inches in thickness. The B21t horizon is dominantly mottled very dark grayish brown (10YR 3/2) but ranges from very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). The kneaded color is dark brown (10YR 4/3 to 4/4). The B22t horizon is dominantly dark yellowish brown (10YR 4/4), but ranges to grayish brown (10YR 5/2). The B3t horizon ranges from 18 to 30 inches in thickness and from very strongly acid to slightly acid in reaction. The underlying material is silty clay loam, silty clay, or clay and ranges from strongly acid to slightly acid.

Parsons soils are associated with Barden, Newtonia, Bronaugh, Summit, Liberal, Barco, Carytown, Cherokee, Creldon, and Keeno soils. The abrupt, lower boundary of the subsurface layer distinguishes Parsons soils from Summit, Barco (see fig. 8, p. 11), and all the other associated soils except the Cherokee and Carytown. Parsons soils have a darker colored or thicker surface layer than the Cherokee and Carytown soils. The underlying material in Parsons soils is acid, but it is alkaline in Carytown soils. Parsons are deeper than Liberal and Barco soils. They lack the fragipan and the chert content that are present in Creldon soils.

Parsons silt loam, 0 to 1 percent slopes (PaA).—This soil is on the tops of wide divides and broad benches (see fig. 3, p. 4). Areas are large and well suited to large machinery. Some areas are more than a mile wide and are several miles long. A profile of this soil is described as representative for the series.

Included with this soil in mapping, in all but the southeastern part of the county, are areas of Barden silt loam, 1 to 4 percent slopes, that make up as much as 10 percent of the acreage mapped, and small areas of Liberal and Barco soils. The Barden soil is on relatively narrow ridgetops, points, and side slopes adjacent to the Breaks-Alluvial land complex. The Liberal and Barco soils are on knobs and slope breaks. Also included is a small acreage of a soil that is similar to this Parsons soil, except that the clay subsoil is at a depth of more than 16 inches. This included soil is mostly in depressions near drainageways in the southwestern part of the county.

Among the important inclusions in the southeastern part of the county are areas of Carytown silt loam and areas of Creldon soils. The Carytown soil makes up about 10 percent of the acreage mapped, and the Creldon soils about 5 percent. The Carytown soil is in small depressions, and the Creldon soils are at the heads of drainageways near lower boundaries. Other important inclusions are a few scattered areas of a soil that is similar to this Parsons soil, except that it has a fragipan. This included soil makes up about 10 percent of the acreage mapped and is on relatively narrow ridgetops and terminal points. The combined acreage of all inclusions generally makes up no more than 20 percent of any mapped area.

This Parsons soil has high available water capacity. Runoff is slow. A very good response to management can be expected. Seasonal droughtiness is the major limitation affecting the use of this soil. The choice of crops is reduced, or moderate conservation practices are required. The soil is suited to corn, sorghums, small grain, grasses, and legumes. Under highly specialized management, row crops can be grown year after year. This soil has a good potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIs-2.

Parsons silt loam, 1 to 3 percent slopes (PaB).—This soil is on the side slopes and relatively narrow tops of divides and broad benches and in depressions. Areas are about 10 acres to more than 80 acres in size. This soil is similar to the one described as representative for the series (see fig. 17, p. 32), except that drainageways, gullies, and eroded spots are more common.

Included with this soil in mapping, in all but the southeastern part of the county, are areas of Barden silt loam, 1 to 4 percent slopes, and small areas of Barco and Liberal soils. The Barden soil makes up as much as 20 percent of mapped areas, and it is on side slopes adjacent to drainageways, on terminal points of ridgetops, and on knobs. The Barco and Liberal soils are on knobs and breaks. Also included is a small acreage of a soil that is similar to Parsons soils, except that the subsoil is at a depth of more than 16 inches. This included soil is on the lower part of slopes near drainageways.

In the southeastern part of the county, the principal inclusions are areas of Carytown silt loam and areas of Creldon silt loam, 1 to 4 percent slopes. The Carytown soil makes up about 10 percent of the acreage mapped, and the Creldon soil 5 percent. The Carytown soil is in depressions or in saddles that cross ridgetops, and the Creldon soil is on terminal points of ridgetops and in narrow bands adjacent to lower boundaries. Also included are areas of a soil that is similar to Parsons soils, except that it has a fragipan. This soil makes up about 10 percent of the acreage mapped. It is on narrow ridgetops or terminal points. Combined, all inclusions generally make up no more than 20 percent of any mapped area.

This Parsons soil is high in available water capacity, and runoff is medium. A good response to management can be expected. This soil is susceptible to erosion. During most years it is droughty in summer and wet in spring and fall. Because of these limitations, the choice

of crops is reduced or special conservation practices are required or both. The soil is suited to corn, sorghum, soybeans, small grain, grasses, and legumes. It has potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIIe–2.

Parsons silt loam, 1 to 3 percent slopes, eroded (PaB2).—This soil is in concave areas adjacent to or near the heads of drainageways. It is also near the break in gradient on long slopes. In most places the areas are about 3 to more than 10 acres in size. Small areas are widely separated, and drainageways dissect many large and small parcels. This soil has a profile that is similar to the one described as representative for the series (see fig. 17, p. 32), except that the surface layer is about 6 inches of very dark grayish-brown silt loam mixed with a small amount of dark grayish-brown silt loam. Erosion scars and a few gullies, most of which are crossable by farm machinery, are common.

Included with this soil in mapping are areas of Barden silt loam, 1 to 4 percent slopes, eroded, on narrow side slopes. This included soil makes up as much as 30 percent of the acreage mapped. Also included are spots of severely eroded soils on side slopes and small scattered areas of uneroded soils on the crest of ridgetops or along drainageways.

This Parsons soil has moderate available water capacity, and runoff is medium. A fair response to management can be expected. The soil is susceptible to further erosion and is subject to seasonal droughtiness and wetness. Susceptibility to further erosion, however, is the major limitation affecting the use of this soil. Because of these limitations, the choice of crops is reduced or special conservation practices are required, or both. This soil is better suited to small grain, legumes, and grasses than to other plants. Corn, sorghums, and soybeans also can be safely grown. Capability unit IIIe–5.

Radley Series

The Radley series consists of deep, nearly level soils of the bottom land. These soils formed in recent stratified silty alluvium washed from nearby upland soils.

In a representative profile, the surface layer is very dark grayish-brown, slightly acid silt loam. The underlying material is friable silt loam about 62 inches or more thick. The upper 8 inches of this material is very dark grayish-brown and is medium acid. The lower part is brown to dark-brown, slightly acid to medium acid silt loam that has a few thin strata of loam and fine sandy loam.

Radley soils are medium in natural fertility and are moderately well drained. Runoff is slow to medium, permeability is moderate, and the available water capacity is very high. Frequent overflows, small, irregular, or poorly shaped fields, and lack of easy access severely limit the use of these soils in most places.

More than half the acreage has been cleared of brush and timber. Corn, sorghums, soybeans, grass, and legume crops are grown. Walnut and other valuable trees, alfalfa, and high-quality grasses are potential uses.

Representative profile of Radley silt loam in an area of Radley and Verdigris silt loams, in a field of soybeans, 1,110 feet south and 10 feet east of the northwest corner of sec. 15, T. 33 N., R. 33 W.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, medium and fine, granular structure; very friable; common roots; few worm channels and casts; slightly acid; abrupt, smooth boundary.

C1—10 to 18 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; massive; stratified; friable; medium acid; clear, smooth boundary.

C2—18 to 52 inches, brown (10YR 4/3) silt loam; massive; friable; few worm channels; slightly acid; gradual, smooth boundary.

C3—52 to 72 inches, dark-brown (10YR 3/3) silt loam; massive; friable; thin strata of loam and fine sandy loam; medium acid.

The Ap horizon, or the A1 horizon, ranges from dark brown (10YR 3/3) to very dark brown (10YR 2/2). In some places it is mottled in the lower part. It is dominantly silt loam but ranges from loam to silty clay loam. The A1 horizon is 10 to 20 inches thick. The layer below the A1 horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2), and in some places it is mottled. Texture is the same as that of the surface layer. This layer has thin strata that are darker or lighter in color, and finer or coarser in texture in many places. Other layers of the underlying material also vary in color and texture. Depth to gravel is more than 50 inches. Between depths of 10 and 40 inches, the content of clay is less than 30 percent. These soils range from medium acid to neutral and are more than 50 inches deep.

Radley soils are in the low meander belt of large streams and in upland drainageways. They are associated with Verdigris, Lanton, Cleora, and Hepler soils. The dark-colored part of the surface layer in Radley soils is thinner than it is in the Verdigris and Lanton soils. Radley soils are finer textured than Cleora soils. They are in lower positions and are less acid than Hepler soils. They are not so gray and so wet as Hepler and Lanton soils.

Radley and Verdigris silt loams (Rv).—This mapping unit consists of nearly level soils in low meander belts along the larger streams. The proportionate extent of these undifferentiated soils varies from place to place, but the total acreage of each is about the same. Showing the soils separately on the soil map is not practical or needed. Most areas are more than 50 acres in size and are long and narrow. Old and new stream channels separate the areas into relatively small, irregularly shaped tracts. A profile of the Radley soil and of the Verdigris soil is described as representative for its respective series.

Included with these soils in mapping are small areas of Cleora fine sandy loam along channels and Hepler soils adjacent to the uplands. Also included are areas of Radley and Verdigris silt loams that are covered with about 6 to 10 inches of light-colored overwash. These inclusions of overwashed soils make up less than 25 percent of any mapped area and are mostly located west of Highway 71 on the flood plains of North and Little North Forks of the Spring River.

A very good response to management can be expected. Wetness caused by frequent overflow is the major limitation affecting the use of these soils. The choice of crops is reduced, or special conservation practices are required, or both. Cleared areas are better suited to corn, sorghums, grasses, and legumes than to other plants. Areas that are small and poorly shaped for cultivation are better suited to walnut or other quality trees than to other uses. Summer row crops can be grown year after year. The soils have a good potential for growing alfalfa and walnut trees. Some areas have a potential for growing vegetables and field crops under irrigation. Capability unit IIIw–1.

Summit Series

The Summit series consists of deep, nearly level to gently sloping soils on uplands. These soils formed under tall prairie grasses in material weathered from calcareous clay, shale, and limestone.

In a representative profile, the surface layer is very dark gray, slightly acid silty clay loam about 8 inches thick. The subsoil is about 36 inches thick. The upper 5 inches of the subsoil is very dark gray silty clay loam, the next 5 inches is very dark gray silty clay, the next 5 inches is light olive-brown silty clay, and the lower 21 inches is olive silty clay loam. The underlying material is coarsely mottled olive-gray and yellowish-brown heavy silty clay loam. It is firm, is mildly alkaline, and overlies stratified shale.

Summit soils are high in natural fertility and are somewhat poorly drained. Permeability is slow, and the available water capacity is high. Susceptibility to erosion and wetness are the major limitations that affect use of these soils.

Corn, wheat, soybeans, and sorghums are the main crops and are grown on about half of the acreage. Most of the remaining acreage is in grasses or legumes that are pastured or mowed for hay.

Representative profile of Summit silty clay loam, 2 to 5 percent slopes, in a field of fescue, 410 feet north and 3,350 feet west of the southeast corner of sec. 6, T. 33 N., R. 33 W.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; strong, very fine, granular structure; friable; common roots; few worm channels and casts; few iron concretions; slightly acid; gradual, smooth boundary.

B1t—8 to 13 inches, very dark gray (10YR 3/1) silty clay loam; moderate, very fine, subangular blocky structure and fine, granular structure; firm; few roots; thin clay films; few worm and root channels; many iron concretions; slightly acid; gradual, smooth boundary.

B21t—13 to 18 inches, very dark gray (N 3/0) silty clay; many, fine, distinct, light olive-brown mottles and common, medium, faint, black (5Y 2/1) mottles; moderate, very fine, angular blocky structure; very firm; few roots; thick clay films; few worm and root channels; many iron concretions; slightly acid; gradual, smooth boundary.

B22t—18 to 23 inches, light olive-brown (2.5Y 5/4) silty clay; common, fine, distinct, very dark gray and black mottles; moderate, fine, angular, blocky structure; very firm; few roots; thick clay films; many iron concretions; neutral; gradual, smooth boundary.

B3t—23 to 44 inches, olive (5Y 5/3) silty clay loam; common, medium, faint, olive-gray (5Y 5/2) mottles, and few, fine, faint, yellowish-brown and very dark gray mottles; weak, medium, subangular blocky structure; firm; few roots; thin clay films; many concretions of iron, and common concretions of calcium carbonate; few fragments of limestone; mildly alkaline; clear, smooth boundary.

C—44 to 57 inches, coarsely mottled, olive-gray (5Y 5/2) and yellowish-brown (10YR 5/6) heavy silty clay loam; few, faint, dark-gray and gray mottles; massive; firm; few roots; common concretions of iron, manganese, and calcium carbonate; mildly alkaline; gradual, smooth boundary.

R—57 to 70 inches, coarsely mottled yellowish-brown (10YR 5/6) and gray (N 6/0) clay shale; weakly stratified; common concretions of iron and manganese; mildly alkaline.

The Ap horizon, or the A1 horizon, ranges from very dark grayish brown (10YR 3/2) to black (2.5YR 2/1) and is medium acid or slightly acid. The B horizon is 30 to 55 inches thick. The B1t horizon is the same color as the A horizon. Its texture ranges from silty clay loam to silty clay. The B21t horizon is black (10YR 2/1) to olive-brown (2.5Y 4/4) silty clay or clay and is medium acid to slightly acid. In some places a few to many, prominent, red mottles are present. The B22t horizon is light olive brown (2.5Y 5/4) or olive (5Y 5/3) to dark yellowish-brown (10YR 4/4) silty clay or clay. In some places many, medium, olive-gray mottles are present, especially in the nearly level soil. The C horizon ranges from slightly acid to mildly alkaline.

Summit soils are associated with Parsons, Carytown, Newtonia, Barden, and Lanton soils. The lower boundary of the surface layer in Summit soils is not abrupt, as it is in Parsons and Carytown soils. Summit soils lack the fragipan that is present in Keeno soils. They have a finer textured subsoil than Newtonia and Lanton soils. Summit soils have a higher content of clay in the surface layer than Barden soils, and the very dark colors extend deeper into the subsoil than they do in those soils.

Summit silty clay loam, 0 to 2 percent slopes (SuA).—This soil is on ridgetops, side slopes, and foot slopes that receive seepage and runoff from higher soils in many places. Areas are few, are longer than they are wide, and are about 10 acres to more than 40 acres in size.

This soil has a profile that is similar to the one described as representative for the series, except that it has little less clay in the surface layer and a little more in the upper part of the subsoil. Also, the subsoil is slightly grayer.

Included with this soil in mapping are areas of Carytown and Lanton soils and small areas of Parsons soils. The Carytown and Lanton soils are at the lower elevations, and the Parsons soils are at the higher elevations.

A very good response to management can be expected. Runoff is medium. Because of seasonal wetness, the use of this soil is limited. The choice of crops is reduced, or moderate conservation measures are required. The soil is suited to corn, sorghums, small grain, soybeans, grasses, and legumes, including alfalfa. Under highly specialized management, row crops may be grown year after year. This soil has a potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIw-1.

Summit silty clay loam, 2 to 5 percent slopes (SuB).—This soil is on ridgetops, side slopes, and foot slopes that receive seepage and runoff from higher soils in places. Most areas are smaller than 40 acres in size. A profile of this soil is described as representative for the series.

Included with this soil in mapping, in the southeastern part of the county, are areas of Carytown silt loam and Parsons soils. The Carytown soil makes up as much as 10 percent of the acreage mapped, and the Parsons soils 5 percent. The Carytown soil is in narrow bands near the lower boundary of side slopes, and the Parsons soils are on the crest of ridgetops. Also included, in the northwestern part of the county, are areas of Barden and Parsons soils. The Barden soils make up 15 to 20 percent of the acreage mapped, and the Parsons soils about 5 percent. The Parsons soils are on ridgetops and side slopes, and the Barden soils are on side slopes in most places.

A very good response to management can be expected. Runoff is moderately rapid. Because this soil is susceptible to erosion, its use is limited. The choice of crops is reduced, or moderate conservation practices are required.

The soil is well suited to corn, sorghums, small grain, soybeans, grasses, and legumes, including alfalfa. The soil has a good potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated. Capability unit IIe–2.

Verdigris Series

The Verdigris series consists of deep, nearly level soils on bottom land. These soils formed in recent, stratified, medium-textured, silty alluvium washed from nearby soils on uplands.

In a representative profile, the surface layer is very dark grayish-brown, slightly acid silt loam about 10 inches thick. The underlying material is friable, slightly acid, and about 62 inches or more thick. The upper 21 inches of this material is very dark brown silt loam that has a few thin strata of silty clay loam and fine sandy loam. The lower part is dark-brown to brown loam that has a few thin strata of fine sandy loam and clay loam.

Verdigris soils are medium in natural fertility and are moderately well drained. Runoff is slow, permeability is moderate, and the available water capacity is very high. The use of these soils is severely limited in most places by frequent overflows; by small, irregular, or poorly shaped fields; and by a lack of easy access. Under good management row crops can be grown year after year.

Less than half the acreage of Verdigris soils has been cleared. Corn, sorghum, soybeans, grass, and legumes are grown. Walnut and other valuable trees, alfalfa, and productive grasses of high quality are potential uses. Some areas also have a potential for growing vegetables and field crops under irrigation in summer.

In this county the Verdigris soils are mapped only in undifferentiated groups with Lanton soils and with Radley soils.

Representative profile of Verdigris silt loam in an area of Radley and Verdigris silt loams, in a field of lespedeza, 130 feet north and 2,165 feet west of the southeast corner of sec. 4, T. 31 N., R. 29 W.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak, medium and fine, granular structure; very friable; common roots; slightly acid; clear, smooth boundary.

AC—10 to 31 inches, very dark brown (10YR 2/2) silt loam; weak, medium, granular structure; friable; few roots; thin strata of silty clay loam and fine sandy loam; few worm channels and casts; few small fragments of partially decomposed carbonaceous material; slightly acid; gradual, smooth boundary.

C—31 to 72 inches, dark-brown (10YR 3/3) loam; massive; friable; few roots; thin strata of fine sandy loam and clay loam; slightly acid.

Soils of the Verdigris series range from neutral to strongly acid and are more than 50 inches deep. Depth to the dark color ranges from 24 to more than 50 inches. Dark grayish-brown (10YR 4/2) mottles occur at a depth of more than 20 inches in places. The Ap horizon, or the A1 horizon, is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2). Texture is dominantly silt loam but ranges from silty clay loam to loam. The A1 horizon is 10 to 25 inches thick. The transitional layer to the underlying material, where present, is as much as 30 inches thick. It is similar to the A1 horizon in texture, but in many places it is darker in color. Other strata that make up the underlying material are dominantly dark brown (10YR 3/3) to dark yellowish brown (10YR 4/4), but darker or lighter strata may be present at varying depths.

Verdigris soils are in the low meander belt of larger streams. They are also in a few upland drainageways. They are associated with soils of the Lanton, Hepler, Radley, and Cleora series. The underlying material in Verdigris soils is coarser, browner, and better drained than it is in Lanton and Hepler soils. The dark surface layer of the Verdigris soils is thicker than it is in Hepler, Radley, and Cleora soils and also is finer textured than the surface layer of Cleora soils.

Use and Management of the Soils

This section describes some basic practices of management for soils used for crops and pasture. The system of capability grouping is defined, and the use and management of the soils in each capability unit are discussed. Also discussed in this section are predicted average yields of the principal field and pasture crops grown under two levels of management and use of the soils for woodland and wildlife. Finally, use of the soils in engineering is described.

Use of the Soils for Crops and Pasture [2]

Most of the soils in Barton County are in crops and pasture. Notable exceptions are the tree-covered soils of the Hector and Nixa series on uplands, limited-access areas of Verdigris and Radley silt loams on bottom lands, and large idle areas of Mine pits and dumps.

Soybeans, corn, wheat, and sorghum are the principal grain crops. Tall fescue, native tall prairie grasses, and lespedeza produce most of the forage. The acreage of alfalfa has quadrupled in the past 5 years. A steady increase in the acreage and relative importance of alfalfa is predicted.

The major limitations to use and management of the soils for field and pasture crops are erodibility, wetness, and droughtiness. All of the soils need management that will help conserve water, maintain or increase the organic-matter content and fertility level, and preserve good tilth. More than half of Barton County is sloping uplands that are susceptible to erosion. This includes 27,719 acres that have already been damaged to a moderate degree by sheet, rill, and gully erosion. In most places a combination of both vegetative and mechanical practices are needed for controlling erosion.

Wet bottom lands need drainage and flood control. Supplemental irrigation of both uplands and bottom lands that can be irrigated, consistent with the available water supply, is desirable. Equally important and urgently needed is pasture seeding and renovation.

Good management increases yields and insures an adequate economic return. A conservation cropping system combines suitable crop rotations with needed management and conservation practices to prevent soil deterioration. Technical assistance in the planning and application practices for the soils of a particular field or farm can be obtained from the Soil Conservation Service through the Barton County Soil and Water Conservation District.

[2] JERRY L. CLOYED, district conservationist, Soil Conservation Service, helped to prepare this section.

The management practices needed for most of the soils that are suitable for crops and pasture are briefly discussed in the following paragraphs. This discussion supplements the management suggestions regarding specific practices given for each capability unit.

High fertility levels increase the yields of grain and forage. Dense-growing crops reduce the destructive impact of falling raindrops on the soil. Large amounts of residue left on the surface after harvest increase the organic-matter content and keep the soil porous, thereby increasing the intake rate and the available water capacity.

Managing plant residue so that it is left on or near the surface also retards runoff and helps to control erosion. The effectiveness in controlling erosion depends on the amount of residue and the length of time it is left on the surface. Thus, spring plowing that allows residue to remain on the surface over winter is more effective than fall plowing, which leaves the surface bare. The use of tillage implements that leave residue on the surface during the growing season is still more effective.

Minimum tillage practices help to maintain good tilth, increase infiltration, and help to reduce erosion. These practices include the use of chisel plows, direct planting of conventionally plowed fields, and other methods that reduce tillage.

Some soils, under special management, can be continuously intertilled without excessive erosion. These include the soils on bottom lands and some of the nearly level soils on uplands. Special management for intensive cropping generally includes maintaining fertility, managing crop residue, and minimum tillage. These practices are combined with grassed waterways, terraces, cross-slope channels or diversion terraces on uplands, or drainage systems in bottoms. Currently, supplemental irrigation is on the increase and will probably become more important in the future.

Grassed waterways are effective in controlling erosion where natural drainageways accumulate runoff water. Properly located, natural or constructed grassed waterways also serve as terrace outlets where terraces are needed. Crossable waterways can be designed that are convenient for farming with large machinery.

Field terraces reduce the length of slope and are the most effective erosion control measure used on cultivated soils that have slopes of more than 1½ percent. Cultivated soils that have slopes of more than 2 percent should generally be terraced and farmed on the contour. A system of terraces that are nearly parallel to each other is better than other systems, because it eliminates excessive point rows and makes farming more convenient.

Cross-slope channels are used to reduce the length of extremely long slopes that have gradients of as much as 1½ percent. These channels, except for a much wider horizontal spacing, are very similar to field terraces.

Diversion terraces are designed and constructed to protect cultivated soils from water that runs off higher lying permanent pasture and woodland.

Outlets for drainage ditches are available in most places. A system of drainage ditches generally provides ordinary drainage. Land leveling and smoothing will improve ordinary drainage. Tile drains are practical in some places. Control of flooding on the flood plains of most of the streams in the county is feasible under existing conservation programs. One such program is Public Law 566, Small Watershed Program, available through the local Barton County Soil and Water Conservation District.

Many good stands of high-yielding grass-legume pastures have been established in Barton County. More new pasture seeding and permanent pasture renovations are needed.

The following combination of management practices to establish and maintain good pasture is commonly used: (1) plow the land in June or July, (2) lime and fertilize according to the needs indicated by soil tests, (3) seed a mixture of good, clean, adapted grasses and legumes when moisture conditions are right late in August or in September, (4) control the weeds and brush, (5) maintain stands and high yields of quality forage by topdressing pasture with fertilizer, (6) maintain good production and utilization of forage plants by changing the number of grazing animals and periodically moving them from one pasture to another. Using pastures for short periods of intensive grazing followed by a longer period of rest is desirable.

Dependable forage for full-year animal needs is obtained if the number of animals is in balance with the average total production of forage. Peak production of forage in spring should be saved for dry periods in summer and for winter.

Several fields are needed, each grazed when ready and then rested for regrowth, in sequence. These fields can be designed and organized to provide forage the year around. It is desirable to store some spring excess as quality hay for efficient animal performance.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs. A complete discussion of the capability classification is given in Agriculture Handbook 210 (*10*).

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (None in Barton County.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Barton County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes. (None in Barton County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States but not in Barton County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-6 or IIw-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Barton County are described and suggestions for the use and management of the soils are given. The numbering of capability units is not consecutive, because a statewide system is used in Missouri and some of the capability units are not represented in the county. The names of the soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series appear in the unit. To find the names of all of the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT IIe-1

This unit consists of soils in the Askew, Bronaugh, and Newtonia series. These are deep, moderately well drained and well drained, gently sloping soils on uplands and stream terraces. They have a loamy surface layer and a loamy or clayey subsoil. Their permeability is moderate, and their available water capacity is high. These soils are susceptible to erosion if they are not protected. The choice of crops is limited, or moderate conservation practices are needed, but response to management is very good.

These soils are suited to corn, sorghums, soybeans, small grain, grasses, alfalfa and other legumes. The potential for growing vegetables and field crops under irrigation is good, but the availability of an adequate water supply limits the acreage that can be irrigated.

Proper use of crop residue, cover crops, and green-manure crops helps to maintain organic-matter content, good tilth, and available water capacity. Terraces, minimum tillage, and contour cultivation help to control erosion and retard runoff. Irrigation supplements the available water capacity.

CAPABILITY UNIT IIe-2

The soils of this unit are in the Barden, Creldon, and Summit series. These are deep, moderately well drained or somewhat poorly drained, gently sloping soils on uplands. They have a loamy surface layer and a clayey or loamy subsoil. Their permeability is moderate to slow, and their available water capacity is moderate to high. If not protected, the soils are susceptible to erosion. Wetness limits their use to a lesser degree. The choice of crops is reduced, or moderate conservation practices are needed. Nevertheless, a very good response to management can be expected.

These soils are suited to corn, sorghums, small grain, soybeans, grasses, and legumes. The better drained areas are suited to alfalfa, and there is a potential for growing vegetables and field crops under irrigation. The availability of an adequate water supply limits the acreage that can be irrigated.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Terraces, minimum tillage, and contour cultivation help to control erosion and retard runoff. Irrigation supplements the available water capacity.

CAPABILITY UNIT IIe-4

Only Barco loam, 2 to 5 percent slopes, is in this unit. This soil is well drained. Its available water capacity is medium, and its permeability is moderate. If not protected, the soil is susceptible to erosion and, to a lesser degree, droughtiness. The choice of crops is reduced, or moderate conservation practices are needed. Nevertheless, a very good response to management can be expected.

This soil is suited to corn, sorghums, small grain, soybeans, and grasses and legumes, including alfalfa. It has potential for growing corn and vegetable crops under irrigation, but the availability of an adequate water supply limits the acreage that can be irrigated.

Proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Terraces, minimum tillage, and contour cultivation help to control erosion and retard runoff. Irrigation supplements the available water capacity.

CAPABILITY UNIT IIw-1

The soils in this unit are in the Cherokee, Hepler, Lanton, Summit and Verdigris series. These are deep, moderately well drained to poorly drained, nearly level soils on bottom lands and uplands. They have a loamy surface layer and a loamy or clayey subsoil. Their permeability is moderate to very slow, and their available water capacity is high or very high. Seasonal wetness caused by runoff, ponding, and overflow is the major limitation. The choice of crops is reduced, or moderate conservation practices are needed. Nevertheless, a good or very good response to management can be expected.

These soils are suited to corn, sorghums, soybeans, small grain, and grasses and legumes, including alfalfa. The potential for growing vegetables and field crops under irrigation is good, but the availability of an adequate water supply limits the acreage that can be irrigated. The soils also have potential for growing walnut and other high-value trees.

The proper use of crop residue, green-manure crops, and cover crops helps to maintain the organic-matter content, good tilth, and available water capacity. Land smoothing, surface ditches, and tile help to reduce scouring and improve drainage. Irrigation supplements the available water capacity, and lime and fertilizer are needed for good plant growth.

CAPABILITY UNIT IIs-2

Parsons silt loam, 0 to 1 percent slopes, is the only soil in this unit. This soil is on uplands and is deep and somewhat poorly drained. It has a loamy surface layer that is abruptly underlain by a clayey subsoil. Its permeability is very slow, and its available water capacity is high. Seasonal droughtiness and, to a lesser degree, wetness and erosion limit the use of this soil. The choice of crops is reduced, or moderate conservation practices are needed, but a good response to management can be expected.

This soil is suited to corn, sorghums, soybeans, small grain, and grasses and legumes. Under highly specialized management, row crops can be grown year after year. The potential for growing vegetables and field crops under irrigation is good, but the availability of an adequate water supply limits the acreage that can be irrigated.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Irrigation supplements the available water capacity. Land smoothing and surface ditches improve drainage, and on long slopes, terraces and cross-slope channels help to control erosion.

CAPABILITY UNIT IIIe-2

Only Parsons silt loam, 1 to 3 percent slopes, is in this unit. This soil is somewhat poorly drained. Its permeability is very slow, and its available water capacity is high. If the soil is cultivated and not protected, its use is severely limited by susceptibility to erosion and, to a lesser degree, droughtiness and wetness. The choice of crops is reduced, or special conservation practices are needed, or both. Only a fair response to management can be expected.

This soil is suited to corn, sorghums, soybeans, small grain, grasses, and legumes. A cropping system that includes legumes or grasses in rotation is desirable. Except in eroded areas, there is a potential for growing vegetables and field crops under irrigation, but the availability of an adequate water supply limits the acreage that can be irrigated.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and the available water capacity. Terracing, minimum tillage, and contour cultivation help to control erosion and retard runoff. Irrigation supplements the available water capacity.

CAPABILITY UNIT IIIe-4

This unit consists of soils in the Askew, Barco, and Bolivar series. These are deep and moderately deep, well drained and moderately well drained, gently sloping soils on upland divides and stream terraces. They have a loamy surface layer and a clayey or loamy subsoil. Their permeability is moderate, and their available water capacity ranges from high to low. If these soils are cultivated and not protected, they are susceptible to erosion and their use is severely limited. The choice of crops is reduced, or special conservation practices are needed, or both. Nevertheless, a good response to management can be expected.

These soils are suited to small grain, sorghums, grasses, legumes, and to a lesser degree, corn and soybeans.

The proper use of crop residue, cover crops and green-manure crops helps to maintain the organic-matter content, good tilth, and the available water capacity. Terraces, minimum tillage, and contour cultivation help to control erosion and retard runoff.

CAPABILITY UNIT IIIe-5

The soils in this unit are in the Barden, Creldon, Lebanon, Liberal, and Parsons series. These are moderately deep and deep, moderately well drained or somewhat poorly drained, gently sloping or sloping soils on the uplands. They have a loamy surface layer and a clayey subsoil. Creldon and Lebanon soils are moderately deep to a fragipan, and Liberal soils have shale at a depth of 40 to 60 inches. Parsons and Barden soils are eroded.

Permeability of these soils is moderate to very slow, and their available water capacity is high or moderate. The soils are susceptible to erosion and are slightly droughty. This severely limits their use. The choice of crops is reduced, or special conservation practices are needed, or both. A good response to management can be expected, however.

These soils are suited to small grain, grasses, legumes, sorghums, corn, and soybeans.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Terraces, minimum tillage, contour cultivation, and controlled grazing help to control erosion and retard runoff.

CAPABILITY UNIT IIIw-1

This unit consists of soils in the Hepler, Radley, and Verdigris series. These soils are deep, moderately well drained to somewhat poorly drained, and nearly level. They have a loamy surface layer and a loamy subsoil. Their permeability is moderate to moderately slow, and their available water capacity is high or very high. Seasonal wetness, caused by ponding and occasional overflow, severely limits the use of these soils. The choice of crops is reduced, or special conservation practices are needed, or both. Nevertheless, a good response to management can be expected.

These soils are suited to sorghums, small grain, corn, soybeans, grasses, and legumes. Soils in the narrow upland drainageways are suited to grasses, legumes, and trees. Under highly specialized management, row crops can be grown year after year. There is a potential for growing vegetables and field crops under irrigation, although the availability of an adequate water supply limits the acreage that can be irrigated.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Land smoothing, channel improvement, surface ditches (fig. 18), and, in places, tile help to reduce scouring and improve drainage. Irrigation supplements the available water capacity.

CAPABILITY UNIT IIIw-2

Only Cleora fine sandy loam is in this unit. This soil is well drained. Its permeability is moderately rapid, and its available water capacity is moderate. Wetness from frequent overflow severely limits the use of this soil. Many areas are small and poorly shaped for farm operations. The choice of crops is reduced, or special conservation practices are needed. Nevertheless, a very good or good response to management can be expected.

Figure 18.—**A well-constructed and well-maintained drainage ditch on Hepler silt loam.**

Cleared areas are suited to corn, sorghums, grasses, and legumes. Summer annual row crops can be grown year after year. The potential for growing alfalfa and walnut trees is good. In some areas the potential is also good for growing vegetables and field crops under irrigation in summer.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the content of organic matter, good tilth, and available water capacity. Land smoothing, channel improvement, and streambank management help to reduce scouring and improve drainage. Irrigation supplements the available water capacity.

CAPABILITY UNIT IIIw-12

Carytown silt loam is the only soil in this unit. This soil is poorly drained. Its permeability is very slow and its available water capacity is moderate. Seepage and runoff cause seasonal wetness and severely limit use of this soil. The choice of crops is reduced, or special conservation practices are needed, but a fair to good response to management can be expected.

This soil is suited to sorghums, small grain, grasses, legumes, corn, and soybeans. It has potential for growing vegetables and irrigated field crops, but the availability of an adequate water supply limits the acreage that can be irrigated.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Land smoothing, surface ditches, and diversion terraces improve drainage. Cross-slope ditches on long slopes, as well as field terraces on included soils that have slopes of more than 2 percent, help to control erosion. Irrigation supplements the available water capacity.

CAPABILITY UNIT IVe-7

In this unit are deep, gently sloping, eroded soils in the Barco, Bolivar, Creldon, and Liberal series. These soils on uplands are well drained and moderately well drained. Their permeability is moderate to slow, and their available water capacity is moderate to low. The soils have a loamy surface layer, a loamy or clayey subsoil, and a fragipan, shale, or sandstone at a moderate depth. Erosion scars, gullies, stream channels, and areas where the clayey subsoil is exposed are common.

If these soils are cultivated and not protected, their use is severely limited by susceptibility to further erosion and, to a lesser degree, by droughtiness. The choice of crops is restricted, careful management is needed, and only a fair response to management can be expected.

These soils are suited to grasses, legumes, and small grain. An occasional crop of sorghum or other row crop can be grown if the cropping system includes hay and pasture crops in long rotations.

The proper use of plant residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Terraces, minimum tillage, and contour cultivation help to control erosion and retard runoff.

CAPABILITY UNIT IVs-8

This unit consists of shallow, well-drained, gently sloping soils in the Collinsville and Hector series. These

soils are on uplands and have a loamy surface layer. Sandstone is at a depth of less than 20 inches. Permeability is moderately rapid or rapid, and the available water capacity is very low. Stony, rocky, or eroded spots are common. Droughtiness and susceptibility to erosion severely limit the use of these soils. The choice of crops is restricted, and careful management is needed. Only a fair response to management can be expected.

These soils are better suited to grasses and legumes than to other plants. Cultivation should be limited to small grain or an occasional row crop grown in rotations that include several years of meadow.

The proper use of plant residue, cover crops and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Minimum tillage and contour cultivation help to control erosion and retard surface runoff, and field terraces are needed in places. Plowing cultivated areas for an occasional grain crop and using chemical sprays help to control weeds. Removing undesirable trees and brush, protecting against fire, and controlling grazing are practices that increase growth in timber stands.

CAPABILITY UNIT IVs-9

Only Keeno cherty silt loam, 2 to 9 percent slopes, is in this unit. This soil is moderately well drained and is medium in natural fertility. It has a cherty, loamy surface layer and a very cherty, loamy subsoil underlain by a very cherty, firm fragipan at a depth of 18 to 36 inches. It has rapid permeability above the fragipan, but the permeability of the fragipan is slow. The available water capacity is low. Fragments of chert and a few stones on or in the surface layer are common. Droughtiness severely limits the use of this soil, and the choice of crops is restricted. Very careful management is needed, and only a fair response to management can be expected.

This soil is suited to grasses, legumes, and small grain. Many areas also are suited to sorghums or other row crops that are grown in rotations that include several years of hay crops.

The proper use of plant residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Minimum tillage and contour cultivation help to control erosion and retard runoff. Chemical sprays help to control brush.

CAPABILITY UNIT VIe-7

The soils in this unit are in the Barco, Collinsville, and Liberal series and in the Breaks-Alluvial land complex. These soils are on uplands and first bottoms. They are well drained to somewhat poorly drained. Some of the soils are deep or moderately deep to shale, and others are shallow or moderately deep to sandstone. The soils have a loamy surface layer and a clayey or loamy subsoil. Their permeability ranges from very slow to moderately rapid, and their available water capacity from high to very low. If protective cover is not maintained, these soils are susceptible to erosion, and to a lesser degree they are droughty. Some areas are stony. Use of these soils is severely limited, and generally only a fair response to management can be expected, though the response ranges from very good to poor.

Much of the acreage of these soils is generally unsuitable for cultivation. Small grain, grasses, and legumes are suited in some places. All but the stony or brushy areas can be mowed. Use of most areas is limited to pasture, woodland, and wildlife food and cover. Native prairie and a small acreage of tame grasses provide needed protective cover for wildlife.

The proper use of crop residue, cover crops, and green-manure crops helps to maintain the organic-matter content, good tilth, and available water capacity. Minimum tillage and contour cultivation help to control erosion and retard runoff. Chemical sprays and mowing aid in controlling weeds and brush in meadows or pastures, and controlled grazing helps to maintain good stands and control erosion. Weed and brush control, seeding, and fertilization by airplane are potential management practices for brushy or stony areas.

CAPABILITY UNIT VIs-8

This unit consists of soils in the Collinsville and Hector series. These soils are shallow, well drained, and sloping to moderately steep. They are on uplands. They have a loamy surface layer, and sandstone is at a depth of less than 20 inches. Permeability is moderately rapid or rapid, and the available water capacity is very low. Rocky, stony, or eroded spots are common. Droughtiness, susceptibility to erosion, stoniness, and rockiness severely limit the use of these soils.

These soils are generally unsuitable for cultivation. Their use is largely limited to pasture, woodland, or wildlife food and cover. The soils are better suited to grasses and legumes than to other plants.

The proper use and management of cover and plant residue help to maintain the organic-matter content and available water capacity. Controlled grazing and contour tillage help to control erosion and retard runoff, and mowing and chemical sprays help to control weeds and brush. The maintenance of a good stand of high-quality grasses and legumes increases the production of hay and pasture. The removal of undesirable trees, protection from fire, and fencing to control or prevent grazing increase timber production.

CAPABILITY UNIT VIs-9

Nixa cherty silt loam, 2 to 9 percent slopes, is the only soil in this unit. This deep soil is on uplands. It has a cherty loamy surface layer and a very cherty loamy subsoil that is underlain by a very cherty, firm fragipan at a depth of 18 to 36 inches. This soil is low in natural fertility and is moderately well drained. It has moderate permeability above the fragipan, but the permeability of the fragipan is very slow. The available water capacity is low. Droughtiness severely limits the use of this soil, and only a fair response to management can be expected.

This soil is generally unsuitable for cultivation. Its use is largely limited to pasture, woodland, and wildlife food and cover. The soil is generally better suited to close-growing grasses and legumes than to other plants. It is also suited to woodland.

Good cover and protection from fire help to maintain the content of organic-matter and the available water capacity. Minimum tillage and contour cultivation help to control erosion and retard surface runoff. Chemical sprays and mowing aid in controlling weeds and brush. The removal of undesirable trees, fire protection, and fencing to prevent grazing increase timber production.

CAPABILITY UNIT VIIe-7

This unit consists only of Mine pits and dumps. The steep, irregularly shaped dumps are a mixture of shale, sandstone, and the original mantle of soil stripped from the coalbeds. The pits are long and narrow, and most of them are filled with water.

Steep slopes, a litter of large sandstones on the surface in places, and many pits and gullies make tillage impractical. Runoff is rapid, and low areas are ponded or seepy. Except in some of the soils included with this mixture of materials, permeability is slow or very slow and the available water capacity is low. The response to management is poor. The scanty cover of brush, weeds, trees, and grasses offers little protection from erosion, which is very severe and will continue if protective cover is not maintained.

The use of Mine pits and dumps largely is restricted to grazing, woodland, or wildlife. Most of the acreage is suited to woodland, wildlife food and cover, and recreation. The small, scattered areas of undisturbed soils are more suitable for grazing.

Clearing the brush, smoothing the dumps, and planting adapted grasses, trees, and shrubs enhance the value of this unit for wildlife, recreation, grazing, and woodland and for growing Christmas trees.

CAPABILITY UNIT VIIs-10

This unit consists of soils in the Collinsville, Hector, and Keeno series. These are shallow and deep, gently sloping to steep, stony soils on uplands. They have a loamy surface layer. Sandstone is at a depth of less than 20 inches, or a fragipan is at a depth of 18 to 36 inches. The soils are well drained or moderately well drained.

Stones on the surface and in the surface layer make these soils unsuitable for cultivation and the use of farm machinery impractical. Only scattered small inclusions of nonstony soils can be mowed or worked for hay or pasture crops. Permeability is moderately rapid in the Collinsville soil and is rapid in the Hector soils. Permeability of the Keeno soils is rapid above the fragipan, but it is slow in the fragipan. The available water capacity is very low or low. Stoniness and droughtiness very severely limit the use of these soils.

The use of these soils is restricted largely to grazing, wildlife, and woodland. All of the acreage is suited to wildlife habitat. Cleared areas are better suited to grazing than to other uses. Narrow bottoms are well suited to woodland.

Good cover helps to maintain the content of organic matter and the available water capacity. Chemical sprays help to control brush and weeds. The removal of undesirable trees, protection from fire, and fencing to control or prevent grazing increase timber production. Aerial spraying to control weeds and brush, seeding, and fertilizing are potential management practices, particularly in prairie areas.

Predicted yields

Table 2 shows the predicted average yields per acre that can be expected for the principal crops grown on the soils of Barton County during the next decade. Average yields per acre of nonirrigated crops under two levels of management are indicated for each kind of soil. They do not apply to a particular field or farm in any given year. These estimates are based on the observations of the soil scientists that made the survey and on information obtained from local farmers, professional agronomists, public and private agencies, demonstration plots, and research data.

Management practices, weather conditions, plant diseases, and insect infestations vary from year to year and from place to place. Differences in any of these, especially in droughts during summer, cause great fluctuations in crop yields. Crop damage can also be locally heavy as a result of wind, hail, torrential rains, or flooding.

Columns A show the yields that can be expected under ordinary management. Columns B reflect the yields that can be expected if an improved type of management is used.

The predictions in columns A are based on the most common combination of management practices ordinarily used by most of the farmers in the county. Crops are generally planted according to field boundaries. Some of the land is terraced, but only rarely are fields contour cultivated. Wet areas are drained, but a better system of drainage is needed. Lime and fertilizer are regularly used, but the rate of application is too low for high yields. Little attention is given to new, adapted, high-yielding varieties of crops. Generally, a systematic plan is not followed. Some fieldwork is not so timely as it should be.

Predictions in columns B are based on an improved combination of management practices used by many farmers in the county. A systematic cropping plan, consistent with the capability of the soils, is followed. Sloping soils on uplands are terraced, and most slopes of more than 2 percent are farmed on the contour. Drainage is provided as needed. Adapted high-yielding varieties of crops are planted. Lime and fertilizer are regularly applied, according to soil tests, for maximum yields. Considerable attention is given to new methods of weed control and crop residue management. All farm operations are timely.

Use of the Soils for Woodland [3]

In 1964 about 21,960 acres, or 6 percent of the county, remained in woodland. Wooded tracts are relatively small, and more than half the acreage is used for grazing.

About 12,000 acres of the soils in the Hector, Bolivar, Nixa, and Lebanon series are in woodland. The rooting depth of these soils is restricted either by sandstone or by a fragipan. Consequently, their use for woodland is limited. Except for isolated small tracts, the remaining soils that are in woodland are on bottom lands, which are well distributed in the county. They are either moderately well suited or well suited to needleleaf and broadleaf trees. Areas of Mine pits and dumps are large, and the total acreage of these is about 12,000 acres. Unless these areas are leveled, they have a better potential for trees for timber, Christmas trees, or other wood products than for other uses.

[3] FRANCIS T. HOLT, woodland conservationist, Soil Conservation Service, helped to prepare this section.

TABLE 2.—*Predicted average yields per acre for the principal crops under two levels of management*

[Yields in columns A are those expected over a number of years under ordinary management; and yields in columns B are those expected under improved management. Absence of a yield figure indicates that the crop is seldom grown, that the soil is not suited to the specified crop, that the soil is not arable, or any combination of these]

Soil	Corn		Wheat		Soybeans		Grain sorghum		Alfalfa		Tall fescue	
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Cwt.	Cwt.	Tons	Tons	Tons	Tons
Askew fine sandy loam, 2 to 5 percent slopes	35	56	26	38	18	30	20	29	2.5	4.2	1.0	2.5
Askew silt loam, 2 to 5 percent slopes	39	62	26	39	19	35	24	39	2.7	4.5	.9	2.6
Askew silt loam, 2 to 5 percent slopes, eroded	30	48	19	32	16	29	20	29	2.0	3.5	.8	2.0
Barco fine sandy loam, 2 to 5 percent slopes	36	55	26	38	19	30	22	34	2.5	4.0	1.0	2.5
Barco fine sandy loam, 2 to 5 percent slopes, eroded	30	45	20	32	16	26	16	25	2.0	3.1	.5	2.0
Barco loam, 2 to 5 percent slopes	40	62	27	40	20	32	25	36	2.6	4.1	1.1	2.6
Barco loam, 2 to 5 percent slopes, eroded	35	50	21	32	15	27	19	28	2.2	3.4	.9	2.1
Barden silt loam, 1 to 4 percent slopes	48	73	28	43	25	40	28	46	2.9	4.9	1.2	2.8
Barden silt loam, 1 to 4 percent slopes, eroded	38	54	22	33	21	31	22	32	2.0	3.6	.9	2.2
Bolivar fine sandy loam, 2 to 5 percent slopes	33	50	25	36	18	29	23	33	2.3	3.6	1.0	2.4
Bolivar fine sandy loam, 2 to 5 percent slopes, eroded	28	43	19	32	15	25	15	24	2.0	3.3	.5	1.8
Breaks-Alluvial land complex											.5	2.0
Bronaugh silt loam, 2 to 5 percent slopes	45	70	28	43	25	37	28	44	3.0	5.0	1.2	2.6
Carytown silt loam	35	55	20	35	19	29	25	35	2.0	3.1	.8	2.1
Cherokee silt loam	36	58	26	39	20	33	24	34	2.0	3.3	.9	2.4
Cleora fine sandy loam	35	60	25	40	26	33	24	36	2.5	4.0	1.0	2.6
Collinsville fine sandy loam, 2 to 5 percent slopes			14	24							1.0	2.0
Collinsville fine sandy loam, 5 to 14 percent slopes											.7	1.4
Collinsville stony fine sandy loam, 2 to 14 percent slopes											.6	1.0
Creldon silt loam, 1 to 4 percent slopes	38	57	25	37	19	30	24	35	2.5	4.0	.9	2.3
Creldon silt loam, 1 to 4 percent slopes, eroded	35	47	21	31	18	29	23	33	2.5	4.0	.8	2.0
Creldon silt loam, deep, 1 to 4 percent slopes	40	64	26	40	21	34	26	39	3.0	4.8	1.0	2.7
Hector fine sandy loam, 2 to 5 percent slopes			12	22							.9	1.9
Hector fine sandy loam, 5 to 14 percent slopes											.6	1.3
Hector stony fine sandy loam, 2 to 14 percent slopes											.5	1.0
Hector stony fine sandy loam, 14 to 30 percent slopes												
Hepler silt loam	52	76	26	39	23	36	29	40	2.5	4.4	1.0	2.6
Hepler silt loam, overwash	54	78	31	41	26	40	39	46	3.0	5.0	1.1	2.8
Hepler-Radley silt loams	50	72	24	38	24	38	28	41	2.5	4.6	1.0	2.7
Keeno cherty silt loam, 2 to 9 percent slopes	25	40	22	33	15	22	15	27	2.0	3.5	1.0	2.2
Keeno stony silt loam, 2 to 9 percent slopes											.5	1.5
Lanton silty clay loam	52	77	31	41	29	39	31	47	3.4	5.2	1.2	2.8
Lanton and Verdigris silt loams	54	78	31	41	29	39	32	47	3.5	5.4	1.3	2.8
Lebanon silt loam, 2 to 5 percent slopes	36	56	24	36	18	29	23	33	2.5	4.0	.9	2.1
Liberal silt loam, 2 to 6 percent slopes	37	57	25	37	19	30	24	34	2.5	4.0	1.0	2.2
Liberal silty clay loam, 2 to 9 percent slopes, eroded	25	39	15	28	14	23	16	27	2.0	3.0	.6	1.7
Liberal, Collinsville and Barco soils, 2 to 14 percent slopes											.8	1.5
Mine pits and dumps												
Newtonia silt loam, 1 to 3 percent slopes	55	79	33	44	29	39	27	45	3.4	5.4	1.2	2.7
Nixa cherty silt loam, 2 to 9 percent slopes									1.5	3.0	.8	1.9
Parsons silt loam, 0 to 1 percent slopes	39	62	28	41	24	35	25	36	2.2	3.5	1.0	2.5
Parsons silt loam, 1 to 3 percent slopes	39	62	28	41	24	35	25	36	2.2	3.5	1.0	2.5
Parsons silt loam, 1 to 3 percent slopes, eroded	30	46	20	30	19	27	22	31	1.5	3.0	.6	1.5
Radley and Verdigris silt loams	55	80	30	42	30	40	36	47	3.5	5.5	1.3	2.9
Summit silty clay loam, 0 to 2 percent slopes	52	70	29	42	25	37	29	42	3.1	4.9	1.2	2.6
Summit silty clay loam, 2 to 5 percent slopes	52	70	29	42	25	37	29	42	3.1	4.9	1.2	2.6

In table 3 the soils of Barton County are placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management when the vegetation on them is similar, and that have about the same potential productivity.

Each woodland group is identified by a three-part symbol, such as 1o7, 3w5, or 4t9. The first part of the symbol, always a number, indicates relative potential productivity of the soils in the group. The numeral 1 indicates very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on site index. Site index is the height, in feet, that the dominant trees of a given species will reach in a natural, unmanaged stand in a stated number of years. For the merchantable timber in this county, the site index is the height reached in 50 years.

Site indexes shown in this survey are estimates based on average values for the same or similar soils reported in "Soil Survey Interpretations for Woodlands in the Boston Mountains and Arkansas Valley and Ridges of Arkansas and Oklahoma" (*11*) and in the woodland section of the soil survey of Dent County, Missouri. Estimates of site index for Mine pits and dumps are based on observations. Management suggestions, where

applicable, are given in the subsection "Capability grouping."

The second part of the symbol identifying a woodland group is a small letter. This letter indicates an important soil property that imposes a slight to severe hazard or limitation in managing the soils of the group for wood crops. A letter *o* shows that the soils have few limitations that restrict their use for trees; *w* shows that water in or on the soil, either seasonally or year round, is the chief limitation; *t* indicates toxic substances within the rooting zone; *d* indicates restricted rooting because of shallowness; and *f* indicates large amounts of coarse fragments in the soil.

The third part of the symbol indicates degrees of hazard or limitation and general suitability of the soils for certain kinds of trees.

The numeral *1* indicates soils that have no or only slight limitations and that are best suited to coniferous species.

The numeral *2* indicates soils that have one or more moderate limitations and are best suited to coniferous species.

The numeral *3* indicates soils that have one or more severe limitations and that are best suited to coniferous species.

The numeral *4* indicates soils that have no or only slight limitations and are best suited to deciduous species.

The numeral *5* indicates soils that have one or more moderate limitations and are best suited to deciduous species.

The numeral *6* indicates soils that have one or more severe limitations and are best suited to deciduous species.

The numeral *7* indicates soils that have no or only slight limitations and are suited to either coniferous or deciduous species.

The numeral *8* indicates soils that have one or more moderate limitations and are suited to either coniferous or deciduous species.

The numeral *9* indicates soils that have one or more severe limitations and are suited to either coniferous or deciduous species.

The numeral *0* indicates that the soils are not suitable for producing timber commercially.

The hazards or limitations that affect management of

TABLE 3.—*Woodland suitability groups of soils, their potential*

Woodland groups, soil series, and map symbols	Potential productivity	
	Species	Site index
Group 1o7: Soils that have very high potential productivity; suited to southern hardwoods: Askew (AkB, AsB, AsB2).	Water oak Sweetgum	100 100
Group 3w5: Seasonally wet soils that have moderately high potential productivity; suited to southern hardwoods: Radley and Verdigris (Rv).	Water oak Cottonwood Pin oak	75 85 80
Group 4f8: Loamy upland soils that have a cherty fragipan; moderate potential productivity; suited to southern pines and upland hardwoods: Nixa (NhC).	Shortleaf pine Upland oaks	[2] 60 60
Group 4o7: Upland soils that have moderate productivity; suited to southern pines and upland hardwoods: Bolivar (BoB, BoB2). Lebanon (LeB).	Upland oaks Shortleaf pine	55 [2] 60
Group 4t9: Steep, irregularly shaped dumps that are a mixture of shale, sandstone, and soil; suited to shortleaf pine: Mine pits and dumps (Mp).	Shortleaf pine	[2] 45
Group 4w3: Seasonally wet soils that have moderate or moderately slow permeability; moderate potential productivity; suited to southern hardwoods: Hepler (Hm, Hp, Hr). Lanton (La, Ld).	Pin oak Pecan	65 63
Group 4w5: Seasonally wet soils that have moderate potential productivity; suited to southern hardwoods: Cleora (Cf).	Water oak Cottonwood	65 75
Group 5d9: Shallow upland soils that have low potential productivity; suited to southern pines and eastern redcedar. Hector (HcB, HcD, HeD, HeE).	Shortleaf pine Upland oak	[2] 50 50

[1] Field plantings only; do not interplant or underplant.
[2] Although this species is nearly nonexistent in the county, this is an indication of the expected productivity.

soils for woodland are seedling mortality, erosion hazard, windthrow hazard, plant competition, and equipment limitations. These are rated for each group shown in table 3 and are briefly defined in the following paragraphs.

Seedling mortality refers to the expected mortality of naturally occurring or planted seedlings, as influenced by soil texture, depth, drainage, flooding, height of the water table, and degree of erosion. Mortality is slight if the expected loss is less than 25 percent; moderate if losses are between 25 and 50 percent; and severe if losses are more than 50 percent.

Erosion hazard is rated according to the risk of erosion on woodland where normal practices are used in managing and harvesting trees. It is slight if erosion control is not an important concern, and is moderate if some attention must be given to reduce soil losses. It is severe if intensive and generally expensive measures must be taken to control erosion.

Windthrow hazard indicates the relative danger of trees being blown over by high winds that normally occur, excluding tornadoes. The hazard is slight if windthrow is no special concern, and it is moderate if roots hold the trees firmly, except when the soil is excessively wet or when the wind is strongest.

The expected competition from unwanted plants is rated slight, moderate, or severe. A rating of slight means that competition from other plants is no special problem. A rating of moderate means that plant competition develops but generally does not prevent an adequate stand from becoming established. A rating of severe means that plant competition prevents trees from restocking naturally.

The ratings for equipment limitations are based on the degree that soils and topographic features restrict or prohibit the use of equipment normally employed in tending a crop of trees. The limitation is slight if there is little or no restriction of the type of equipment that can be used or the time of year that equipment can be used. It is moderate if the use of equipment is seasonally limited or if modified equipment or methods of harvesting are needed. The limitation is severe if special equipment is needed or if the use of such equipment is severely restricted by one or more unfavorable soil characteristics. These unfavorable soil characteristics include drainage, slope, number or size of stones, and soil texture.

productivity, hazards and limitations to management, and suitable trees

Management hazards and limitations					Species suitability	
Seedling mortality	Erosion hazard	Windthrow hazard	Plant competition	Equipment limitations	To favor in existing stands	Use for planting
Slight	Slight	Slight	Moderate	Slight	Water oak, sweetgum, sycamore.	Sweetgum.
Moderate	Slight	Slight	Moderate	Moderate	Water oak, cottonwood, sycamore.	Cottonwood,[1] sycamore.
Moderate to severe.	Moderate to severe.	Moderate	Slight	Slight	Upland oaks, black walnut.	Shortleaf pine, blackwalnut.[3]
Slight	Slight	Slight	Slight	Slight	Upland oaks	Shortleaf pine.
Severe	Severe	Slight	Slight	Moderate		Shortleaf pine.
Moderate	Slight	Slight	Severe	Moderate	Pin oak, pecan	Pecan.
Slight	Slight	Slight	Moderate	Moderate	Water oak, cottonwood, sycamore.	Cottonwood, [1] sycamore.
Moderate to severe.	Moderate to severe.	Moderate	Slight	Moderate to severe.	Redcedar, upland oak	Shortleaf pine, redcedar.

[3] Confine to "cool" slopes, coves, benches, and slope bases.

Use of the Soils for Wildlife

The soils and waters of Barton County provide habitat for many kinds and an abundance of game and non-game birds, animals, and fish. Habitats suitable for open land wildlife are the most numerous and best distributed. Bobwhite quail, cottontail rabbit, fox squirrel, gray squirrel, and prairie chicken are the most important. Bass, bluegill, and catfish abound in the more than 3,000 acres of open water in the major streams, large mine pits, farm ponds, and reservoirs. Mink, muskrat, raccoon, and beaver, the important furbearers, also reside close to these waters. White-tailed deer are on the increase, especially in the interspersed woodland and cropland on soils near the larger streams.

Planning wildlife habitats for maximum use and production does not necessarily mean that definite areas must be set aside for this purpose. Most of the wildlife is in areas of soils used mainly for grain, hay, pasture, or forest. For example, the number of prairie chickens, jackrabbits, and other prairie birds and mammals is directly related to the extensive, but rapidly declining, acreage of native prairie in the county. As the acreage in native prairie declines, so does the number of wildlife. Mostly, only small areas of land are used for the specific purpose of producing food and cover for wildlife.

Elements of wildlife habitat and classes of wildlife

The soils of the county have been rated according to their limitations for development as wildlife habitat. In rating the soils the following soil characteristics and soil qualities were given major emphasis: effective depth, texture of surface layer, natural drainage class, surface stoniness, flooding, slope, reaction, and available water capacity. Important factors that were not considered are: existing vegetation, present land use, size of area, shape and location, and the movement of wildlife from place to place.

In addition to the information given here, information that can be related to the use of the soils for wildlife habitat can be found in other sections of this survey. For example, the management suggested for cropland and pasture in the subsection "Use of the Soils for Crops and Pasture" also applies to planted patches of food and cover for wildlife. The section "Use of the Soils for Woodland" contains a table that lists the trees suited to various soils. It is well to keep in mind, however, that trees undesirable for commercial timber are not necessarily undesirable for wildlife habitats. The section "Engineering Uses of the Soils" contains information on water control and pond construction that can be useful in creating desirable wildlife habitat.

The estimated degree and kind of limitations affecting the use of the soils as wildlife habitat are shown in table 4. The ratings provided are helpful in selecting the sites and planning and developing wildlife habitat. They also indicate the limitations affecting the use of the soils as habitat for open land, woodland, and wetland wildlife.

A rating of *good* indicates that wildlife habitat generally is easily created, improved, or maintained. There are few or no limitations that affect wildlife habitat management, and satisfactory results are well assured. A rating of *fair* indicates that wildlife habitat generally can be created, improved, or maintained, but there are moderate soil limitations that affect wildlife habitat management. Moderately intensive management and fairly frequent attention are required to assure satisfactory results. A rating of *poor* indicates that wildlife habitat generally can be created, improved, or maintained on these soils, but that soil limitations are severe. Wildlife habitat management is difficult and expensive or it requires intensive effort. A rating of *very poor* indicates that wildlife habitat cannot be created, improved, or maintained, or in the judgment of the soil scientist making the rating, it is impractical to do so.

Most managed wildlife habitats are created, improved, or maintained by (1) planting suitable vegetation; (2) manipulating existing vegetation; (3) inducing natural establishment of desired plants; or (4) combinations of such measures. The eight elements of wildlife habitat selected for ratings are discussed in the following paragraphs.

Grain and seed crops are grain or seed-producing annuals planted to produce food for wildlife. These crops include corn, soybeans, wheat, oats, millet, and sorghum.

Domestic grasses and legumes are domestic perennial grasses and herbaceous legumes planted to provide wildlife cover and food. These plants include fescue, bromegrass, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, and lespedeza.

Wild herbaceous upland plants are native or introduced perennial grasses and weeds that provide food and cover, principally to upland forms of wildlife, and that are established mainly through natural processes. These plants include big bluestem, little bluestem, some of the panicums, and other native grasses and partridge peas, beggarticks, various native lespedezas, and other native herbs, which may be used as food or cover by various kinds of wildlife.

Hardwood woodland plants are nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, twigs, or foliage used extensively as food by wildlife, and which are commonly established through natural processes but also may be planted. These plants include dogwood, sumac, sassafras, persimmon, hazelnut, shrub lespedezas, wild cherry, autumn-olive, various oaks, hickory, grape, plum, blackberry, blackhaw, honeysuckle, and rose.

Coniferous woodland plants are cone-bearing trees and shrubs that are important to wildlife primarily as cover but also furnish food in the form of browse, seeds, or fruitlike cones. Examples are Virginia pine, white pine, shortleaf pine, Scotch pine, red pine, and redcedar. The rating is based on growth-rate limitations that produce dense, low foliage and delayed closure of the canopy, rather than on timber production.

Wetland food and cover plants are annual and perennial wild herbaceous plants in moist to wet sites, exclusive of floating or submerged aquatics. These plants produce food or cover used mainly by wetland forms of wildlife. Examples are smartweed, bulrush, barnyard grass, duckweed, pondweed, pickerelweed, cattail, and various sedges.

Shallow water developments are impoundments or excavations for control of water, generally not more than 5 feet in depth. Examples are low dikes and levees; shallow dugouts, such as borrow pits along highways and

levees; level ditches; and devices for water-level control in marshy streams or channels.

Excavated ponds are dug-out water areas or combination dug-out and dammed areas that have water of suitable quality and depth and in ample supply for the production of fish or wildlife. Hillside ponds or embankment-type ponds may be suitable in some places but are not rated, because they generally are constructed on sites not typical of the soil mapping unit and are influenced by other site factors.

As shown in table 4, there are three main classes of wildlife. These classes are defined as follows:

Open-land wildlife consists of birds and mammals that normally make their homes on cropland, pastures, lawns, and areas overgrown by grasses, herbs, and shrubby plants. Examples of this kind of wildlife are bobwhite quail, prairie chicken, meadowlark, field sparrow, redwing blackbird, cottontail rabbit, jackrabbit, red fox, and woodchuck.

Woodland wildlife consists of birds and mammals that normally make their homes in areas wooded with hardwood trees and shrubs, coniferous trees and shrubs, or mixtures of such plants. Examples are thrush, vireo, scarlet tanager, dove, turkey, squirrel, gray fox, deer, and raccoon.

Wetland wildlife consists of birds and mammals that normally make their homes in wet areas such as ponds, marshes, and swamps. Examples are duck, geese, heron, mink, muskrat, and raccoon.

Use of the Soils for Recreation

The demand for outdoor recreation in Missouri continues to grow at a rapid rate. Most of the soils in Barton County can be converted to one or more recreational uses. Many recreational facilities are now available in the county. (See the subsection "Cultural and Recreational Facilities.") Physical and economic, as well as other considerations, determine the potential of an area for recreation. For the most part, the kind of soil determines the type and location of recreational facilities.

Basic information about soils is needed for the comprehensive planning and development of outdoor recreation areas. Soil characteristics and qualities that affect such use are wetness, flooding, permeability, slope, texture of the surface soil, depth to bedrock, coarse fragments on the surface, stoniness, and rockiness. The limitations of the soils in Barton County for septic tank filter fields, access roads and parking lots, and foundations for low buildings are shown in a table in the subsection "Engineering Uses of the Soils." Other related information is in the subsections "Use of the Soils for Wildlife" and "Use of the Soils for Woodland." Information in the subsection "Capability grouping" may also be helpful. Advice and assistance on area plantings and soil and water conservation can be obtained from the local office of the Soil Conservation Service.

The estimated degree and kind of limitations of the soils for recreational uses are shown in table 5. Each of the soils in the table is rated for five recreational activities. Because these ratings are general, onsite investigation is needed for detailed planning.

A rating of *slight* indicates that no problems are expected, or that they can be dealt with in the normal course of construction. A rating of *moderate* indicates that problems exist that will require special construction methods or careful planning, or that the site is of medium quality. A rating of *severe* indicates that special planning or major corrective measures are needed, or that the site is either of low quality or not suited to the use specified.

The following paragraphs are descriptions of the outdoor recreational uses for which the soils are rated in table 5.

Picnic areas are areas suitable for picnic tables and unsurfaced parking lots for automobiles. Good foot trafficability, good ground cover, and an attractive landscape are important. Ratings do not include suitability for picnic shelters or toilets, or the presence of trees.

Playgrounds are areas suitable for organized games, such as baseball, football, or tennis. They require a level surface, good drainage, and good foot trafficability.

Campsites are areas suitable for tents and trailers and the accompanying activities of outdoor living. Use of these areas is limited to the camping season. Little preparation ought to be needed, but an attractive landscape and good foot trafficability are important.

Paths and trails are footpaths, bridle trails, and other trafficways provided for walking, running, and riding. Little grading and shaping ought to be necessary. Dust, design, and maintenance of trafficways are important considerations.

Golf fairways require soils that are well suited to grass that will stand frequent mowing to a height of less than 3 inches.

Engineering Uses of the Soils [4]

Engineers have a special interest in soil properties that affect the construction and maintenance of roads, airports, pipelines, foundations for buildings, facilities for storing water, erosion control structures, drainage, and sewage disposal systems. Contractors, farmers, and others who use the soil as a structural or foundation material also need this kind of soil information. Among the soil properties most important to the engineer are particle-size distribution, permeability, drainage, plasticity, density, shrink-swell potential, reaction, and depth to hard rock.

The information in this subsection about these and related soil properties is especially useful in preliminary engineering investigations and evaluations. Information in this soil survey can be used to—

1. Plan and design agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures to conserve soil and water.
2. Select and develop sites for industries, businesses, residences, and recreation areas.
3. Determine the availability of local sources of sand, gravel, or rock for use as construction material.
4. Select locations for highways, railroads, pipelines, airports, cables, sewage disposal fields, or sewage lagoons.

[4] JAMES F. TINDALL, agricultural engineer, Soil Conservation Service, helped to prepare this subsection.

TABLE 4.—*Potential of the soils for elements of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous upland plants	Hardwood woodland plants
Askew: AkB, AsB, AsB2	Good	Good	Good	Good
Barco: BaB, BaB2, BcB, BcB2	Fair: bedrock at a depth of 20 to 40 inches.	Good	Good	Good
Barden: BdB, BdB2	Good	Good	Good	Good
Bolivar: BoB, BoB2	Fair: bedrock at a depth of 20 to 40 inches.	Good	Good	Good
Breaks-Alluvial land complex: Br. Too variable to be rated.				
Bronaugh: BsB	Good	Good	Good	Good
Carytown: Ca	Poor: poorly drained.	Fair: poorly drained.	Fair: poorly drained.	Fair: poorly drained.
Cherokee: Ce	Fair: somewhat poorly drained.	Good	Good	Good
Cleora: Cf	Poor: flooding	Fair: flooding	Fair: flooding	Good
Collinsville:				
CoB	Very poor: low available water capacity.	Poor: low available water capacity.	Poor: low available water capacity.	Very poor: low available water capacity.
CoD, CrD	Very poor: low available water capacity.	Poor: low available water capacity.	Poor: low available water capacity.	Very poor: low available water capacity.
Creldon: CsB, CsB2, CtB	Good	Good	Good	Good
Hector:				
HcB	Very poor: low available water capacity.	Poor: low available water capacity.	Poor: low available water capacity.	Very poor: low available water capacity.
HcD, HeD, HeE	Very poor: low available water capacity.	Poor: low available water capacity.	Poor: low available water capacity.	Very poor: low available water capacity.
*Hepler: Hm, Hp, Hr. For Radley part of Hr, see Radley series.	Poor: flooding	Fair: flooding	Fair: flooding	Good

wildlife habitat and for kinds of wildlife

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous woodland plants	Wetland food and cover plants	Shallow water developments	Open-land	Woodland	Wetland
Good	Poor: moderately well drained.	Poor: moderately well drained.	Good	Good	Poor.
Good	Poor: well drained	Very poor: well drained.	Good	Good	Very poor.
Good	Poor: moderately well drained.	Poor: moderately well drained.	Good	Good	Poor.
Good	Poor: well drained	Very poor: well drained.	Good	Good	Very poor.
Good	Poor: well drained	Very poor: well drained.	Good	Good	Very poor.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Good	Good	Fair: somewhat poorly drained.	Good	Good	Fair.
Good	Poor: well drained	Very poor: well drained.	Fair	Good	Very poor.
Very poor: low available water capacity.	Poor: well drained	Very poor: well drained.	Poor	Very poor	Very poor.
Very poor: low available water capacity.	Very poor: slope	Very poor: slope	Poor	Very poor	Very poor.
Good	Poor: moderately well drained.	Poor: moderately well drained.	Good	Good	Poor.
Very poor: low available water capacity.	Poor: well drained.	Very poor: slope	Poor	Very poor	Very poor.
Very poor: low available water capacity.	Very poor: slope	Very poor: slope	Poor	Very poor	Very poor.
Good	Good	Fair: somewhat poorly drained.	Fair	Good	Fair.

TABLE 4.—*Potential of the soils for elements of*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous upland plants	Hardwood woodland plants
Keeno:				
KeC	Fair: slope	Good	Good	Good
KnC	Poor: stony	Fair: stony	Good	Good
*Lanton: La, Ld For Verdigris part of Ld, see Verdigris series.	Poor: flooding	Fair: flooding	Fair: flooding	Fair: poorly drained.
Lebanon: LeB	Good	Good	Good	Good
*Liberal: LlB, LmC2, LoD For Barco and Collinsville parts of LoD, see Barco and Collinsville series.	Fair: bedrock at a depth of 20 to 40 inches.	Good	Good	Good
Mine pits and dumps: Mp. Too variable to be rated.				
Newtonia: NeB	Good	Good	Good	Good
Nixa: NhC	Fair: slope	Good	Good	Good
Parsons:				
PaA	Fair: somewhat poorly drained.	Good	Good	Good
PaB, PaB2	Fair: somewhat poorly drained.	Good	Good	Good
*Radley: Rv For Verdigris part of Rv, see Verdigris series.	Poor: flooding	Fair: flooding	Fair: flooding	Good
Summit:				
SuA	Good	Good	Good	Good
SuB	Good	Good	Good	Good
Verdigris Mapped only in undifferentiated groups with Lanton soils and Radley soils.	Poor: flooding	Fair: flooding	Fair: flooding	Good

wildlife habitat and for kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous woodland plants	Wetland food and cover plants	Shallow water developments	Open-land	Woodland	Wetland
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Fair	Good	Very poor.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Good	Poor: moderately well drained.	Very poor: slope	Good	Good	Very poor.
Good	Poor: moderately well drained.	Very poor: slope	Good	Good	Very poor.
Good	Poor: well drained	Very poor: well drained.	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Fair: somewhat poorly drained.	Fair: somewhat poorly drained.	Good	Good	Fair.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: moderately well drained.	Poor: moderately well drained.	Fair	Good	Poor.
Good	Poor: moderately well drained.	Poor: moderately well drained.	Good	Good	Poor.
Good	Poor: moderately well drained.	Very poor: slope	Good	Good	Very poor.
Good	Poor: well drained	Very poor: well drained.	Fair	Good	Very poor.

TABLE 5.—*Limitations of soils for specified recreational developments*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Picnic areas	Playgrounds	Campsites	Paths and trails	Golf fairways
Askew: AkB, AsB, AsB2	Slight	Moderate: slope	Slight	Slight	Slight.
Barco: BaB, BaB2, BcB, BcB2	Slight	Moderate: slope	Slight	Slight	Slight.
Barden: BdB, BdB2	Slight	Moderate: slope	Slight	Slight	Slight.
Bolivar: BoB, BoB2	Slight	Moderate: slope	Slight	Slight	Slight.
Breaks-Alluvial land complex: Br. Too variable to be rated.					
Bronaugh: BsB	Slight	Moderate: slope	Slight	Slight	Slight.
Carytown: Ca	Severe: wetness	Severe: very slow permeability.	Severe: very slow permeability.	Severe: wetness	Severe: wetness.
Cherokee: Ce	Moderate: wetness.	Severe: very slow permeability.	Severe: very slow permeability.	Moderate: wetness.	Moderate: wetness.
Cleora: Cf	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding.	Severe: flooding.
Collinsville:					
CoB	Slight	Severe: shallow to bedrock.	Slight	Slight	Slight.
CoD	Moderate: slope	Severe: shallow to bedrock.	Moderate: slope	Slight	Slight.
CrD	Moderate: slope, stony.	Severe: shallow to bedrock.	Moderate: slope	Slight	Severe: stony.
Creldon: CsB, CsB2, CtB	Slight	Moderate: slow permeability; slope.	Moderate: slow permeability.	Slight	Slight.
Hector:					
HcB	Slight	Severe: shallow to bedrock.	Slight	Slight	Slight.
HcD	Moderate: slope	Severe: shallow to bedrock.	Moderate: slope	Slight	Slight.
HeD	Moderate: slope; stony.	Severe: shallow to bedrock.	Severe: stony	Severe: stony	Severe: stony.
HeE	Severe: slope	Severe: shallow to bedrock.	Severe: slope	Severe: slope	Severe: slope.
*Hepler: Hm, Hp, Hr. For Radley part of Hr, see Radley series.	Moderate: flooding.	Moderate: flooding.	Severe: flooding	Moderate: flooding.	Moderate: flooding.
Keeno:					
KeC	Moderate: coarse fragments.	Severe: coarse fragments.	Moderate: coarse fragments.	Moderate: coarse fragments.	Severe: coarse fragments.
KnC	Moderate: stony	Severe: stony	Severe: stony	Severe: stony	Severe: stony.
*Lanton: La, Ld. For Verdigris part of Ld, see Verdigris series.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.
Lebanon: LeB	Slight	Moderate: slope; slow permeability.	Moderate: slow permeability.	Slight	Slight.
*Liberal:					
LlB	Slight	Moderate: slope	Moderate: slow permeability.	Slight	Slight.
LmC2	Moderate: silty clay loam surface layer.	Severe: slope	Moderate: slow permeability.	Moderate: silty clay loam surface layer.	Slight.
LoD. For Barco and Collinsville parts of LoD, see Barco and Collinsville series.	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Moderate: slope.
Mine pits and dumps: Mp. Too variable to be rated.					

TABLE 5.—*Limitations of soils for specified recreational developments*—Continued

Soil series and map symbols	Picnic areas	Playgrounds	Campsites	Paths and trails	Golf fairways
Newtonia: NeB	Slight	Moderate: slope.	Slight	Slight	Slight.
Nixa: NhC	Moderate: coarse fragments.	Severe: slope	Moderate: coarse fragments.	Moderate: coarse fragments.	Severe: coarse fragments.
Parsons: PaA, PaB, PaB2	Moderate: wetness.	Severe: very slow permeability.	Severe: very slow permeability.	Moderate: wetness.	Moderate: wetness.
*Radley: Rv. For Verdigris part, see Verdigris series.	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding.	Severe: flooding.
Summit: SuA, SuB	Slight	Moderate: slow permeability.	Moderate: slow permeability.	Slight	Slight.
Verdigris. Mapped only in undifferentiated groups with Lanton and Radley soils.	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding.	Severe: flooding.

5. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
6. Select sites and correlate the performance of different kinds of roads, structures and other works of engineering with the individual soils for better design and maintenance.

These engineering interpretations, in conjunction with the soil map to identify the soils, can be used for many other purposes. The interpretations reported here do not eliminate the need for onsite investigations. Sampling and testing at the site are needed for specific engineering works nvolving heavy loads and where the excavations are deeper than the layers here reported. Even in these situations, the soil map and interpretations are helpful in planning more detailed field investigations, and for indicating the kinds of problems that may be expected.

Some terms used by soil scientists may be unfamiliar to engineers. The same word may mean something different to an engineer than it does to a soil scientist. Gravel, sand, silt, clay, and horizon are examples of words that have special meaning in soil science. These and other terms are defined in the Glossary at the back of this survey.

Most of the information in this subsection is in tables 6, 7, and 8. Table 6 gives estimates of some soil properties that are significant to engineering. In table 7 are interpretations of engineering properties. Table 8 presents engineering test data that were obtained from three soils sampled in the county.

Engineering classification systems

Two systems are commonly used by engineers to classify soils (*5*). They are the system of the American Association of State Highway Officials (AASHO) (*1*) and the Unified system (*12*).

Most highway engineers classify soil materials in accordance with the classification developed by the American Association of State Highway Officials (AASHO). The system is based on field performance of the highways. The soil materials are classified in seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength and the best soils for road fill. The A–7 group consists of clayey soils that have low strength when wet and are the poorest soils. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are separated as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, and A–7–5, A–7–6. If soil material is near a classification boundary, it is given a symbol showing both classes; for example, A–2 or A–4. The AASHO classification of the soils of Barton County range from A–2 through A–7. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from zero for the best material to 20 for the poorest. Group index numbers have been assigned only to soils on which tests have been performed. They are shown in parentheses after the soil group symbols in the AASHO classification in table 8.

Many engineers, including some highway engineers, classify soils according to the Unified system of soil classification. In the Unified system, soils are classified according to particle-size distribution, plasticity, and liquid limit. The soil materials are identified as coarse grained, eight classes; fine grained, six classes; and highly organic. Within these classes two letters, for example, ML, are used to indicate the kind of soil material and to designate each soil group. The letters used to indicate kinds of soil material are G, S, M, and C, which stand for gravel, sand, silt, and clay, respectively. The letter O is used to indicate a high content of organic matter. The letters W, P, L, and H stand for well graded, poorly graded, low liquid limit, and high liquid limit, respectively. Soils on the borderline between two classification are given a joint classification, for example, ML–CL.

TABLE 6.—*Estimated soil properties*

[An asterick in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first

Soil series and map symbols	Depth to— Bedrock	Depth to— Seasonal high table water	Depth from surface of typical profile	Classification USDA texture
	Feet	*Feet*	*Inches*	
Askew: AkB, AsB, AsB2	5	1½–3	0–10	Silt loam
			10–72	Silty clay loam
Barco: BaB, BaB2, BcB, BcB2	1½–3½	3	0–11	Loam
			11–23	Loam
			23–34	Sandy clay loam
Barden: BdB, BdB2	5	1½–3	0–11	Silt loam
			11–18	Silty clay loam
			18–30	Silty clay
			30–72	Silty clay loam
Bolivar: BoB, BoB2	1½–3½	3	0–13	Fine sandy loam
			13–23	Clay loam
			23–28	Gravelly sandy clay loam
Breaks-Alluvial land complex: Br. Properties too variable to be estimated.				
Bronaugh: BsB	5	4–6	0–7	Silt loam
			7–15	Silty clay loam
			15–36	Silty clay
			36–72	Silty clay loam
Carytown: Ca	6	[2] 0–1	0–15	Silt loam
			15–48	Clay
			48–72	Silty clay loam
Cherokee: Ce	6	[2] 0–1½	0–18	Silty clay loam
			18–42	Clay
			42–72	Silty clay loam
Cleora: Cf	5	[3] 3–5	0–50	Fine sandy loam
			50–60	Gravelly fine sandy loam
Collinsville: CoB, CoD, CrD	1–1½	1–1½	0–13	Fine sandy loam
Creldon: CsB, CsB2, CtB	5	1½–3½	0–10	Silty loam
			10–20	Silty clay loam
			20–45	Very cherty silty clay loam (fragipan).
			45–60	Cherty clay
Hector: HcB, HcD, HeD, HeE	1–1½	1–1½	0–13	Fine sandy loam
*Hepler: Hm, Hp, Hr. For Radley part of Hr, see Radley series.	6	[3] 1–3½	0–20	Silty loam
			20–72	Silty clay loam
Keeno: KeC, KnC	5	1½–2½	0–16	Cherty silty loam
			16–27	Very cherty silty clay loam
			27–42	Very cherty silty loam (fragipan)
			42–72	Very cherty silty clay

See footnotes at end of table.

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions column of this table. The symbol < means less than]

Classification—Continued		Percentage passing sieve—			Reaction [1]	Permeability	Available water capacity	Shrink-swell potential
Unified	AASHO	No.4 (4.7 mm.)	No.10 (2.0 mm.)	No.200 (0.074 mm.)				
					pH	*Inches per hour*	*Inches per inch of soil*	
ML	A-4	100	100	81-85	5. 6-6. 0	0. 6-2. 0	0. 14-0. 20	Low.
CL	A-6	100	100	83-87	4. 5-5. 0	0. 6-2. 0	0. 16-0. 18	Moderate.
ML	A-4	100	97-100	52-65	5. 1-5. 5	0. 6-2. 0	0. 15-0. 20	Low.
ML or CL	A-4 or A-6	100	96-100	60-72	4. 5-5. 0	0. 6-2. 0	0. 16-0. 20	Low to moderate.
CL	A-6	86-97	85-96	58-64	4. 5-5. 5	0. 6-2. 0	0. 16-0. 18	Moderate.
ML	A-4	100	100	79-81	5. 1-5. 5	0. 6-2. 0	0. 18-0. 22	Low.
CL	A-6	100	100	81-85	4. 5-5. 0	0. 2-0. 6	0. 16-0. 18	Moderate.
CL or CH	A-7-6	100	100	83-87	4. 5-5. 5	0. 6-2. 0	0. 11-0. 13	High.
CL	A-6	100	100	79-90	5. 1-6. 0	0. 2-0. 6	0. 16-0. 18	Moderate.
ML	A-4	100	97-100	51-77	5. 1-6. 0	2. 0-6. 0	0. 14-0. 16	Low.
ML or CL	A-6	100	99-100	50-80	4. 5-5. 5	0. 6-2. 0	0. 16-0. 18	Low to moderate.
CL	A-6	85-95	83-90	35-60	4. 5-5. 0	0. 6-2. 0	0. 13-0. 17	Moderate.
ML-CL	A-4-6	100	98-100	82-85	5. 1-6. 0	0. 6-2. 0	0. 19-0. 21	Low.
CL or CH	A-6	100	95-100	83-87	5. 1-5. 5	0. 6-2. 0	0. 16-0. 18	Moderate.
CH	A-7-6	100	95-100	85-88	5. 1-6. 0	0. 6-2. 0	0. 11-0. 13	High.
CL or CH	A-7-6	100	90-95	79-89	5. 1-6. 0	0. 6-2. 0	0. 16-0. 18	Moderate.
ML	A-4	100	94-97	83-87	5. 1-6. 0	0. 6-2. 0	0. 19-0. 21	Low.
CH	A-7-6	100	95-98	85-89	5. 6-7. 3	<0. 06	0. 08-0. 10	High.
CH	A-7-6	100	98-100	82-86	7. 4-7. 8	0. 2-0. 6	0. 16-0. 18	High.
ML	A-4	100	100	83-93	5. 1-6. 5	0. 6-2. 0	0. 19-0. 21	Low.
CH	A-7-6	100	100	95-97	4. 5-5. 5	<0. 06	0. 19-0. 20	High.
CL	A-6	100	100	88-91	4. 5-5. 0	0. 2-0. 6	0. 16-0. 18	Moderate.
SM or ML	A-4	100	96-99	46-60	5. 1-5. 5	2. 0-6. 0	0. 13-0. 15	Low.
SM or ML	A-4	98-100	85-95	42-55	5. 1-6. 0	3. 5-6. 0	0. 06-0. 14	Low.
SM or ML	A-4	98-100	95-99	42-62	5. 1-6. 0	2. 0-6. 0	0. 11-0. 16	Low.
ML	A-4	100	100	81-84	4. 5-5. 5	0. 6-2. 0	0. 18-0. 22	Low.
CL	A-7-6	100	98-100	85-90	4. 5-5. 5	0. 6-2. 0	0. 16-0. 19	Moderate.
SC or CL	A-4 or A-7-6	75-88	50-70	45-65	4. 5-5. 5	<0. 06	0. 05	Low.
CH	A-7-5	80-96	68-96	63-88	4. 5-5. 5	0. 06-0. 2	0. 07-0. 09	Moderate to high.
SM or ML	A-4	99-100	95-99	40-60	4. 5-6. 5	6. 0-9. 0	0. 11-0. 15	Low.
ML-CL	A-4	100	100	92-98	5. 1-5. 5	0. 6-2. 0	0. 19-0. 22	Low.
CL	A-6	100	100	87-95	5. 1-5. 5	0. 2-0. 6	0. 16-0. 19	Low to moderate.
ML	A-4	68-88	65-79	52-67	5. 1-6. 0	2. 0-6. 0	0. 14-0. 18	Low.
GM or ML-CL	A-4	46-61	42-60	37-56	5. 1-5. 5	0. 6-2. 0	0. 06-0. 12	Low.
GM	A-2-4	36-52	31-42	21-36	4. 5-5. 5	<0. 06	0. 05	Low.
GM or MH-CH	A-6	55-66	50-64	40-60	5. 6-6. 5	0. 06-0. 2	0. 04-0. 08	Moderate.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface of typical profile	Classification
	Bedrock	Seasonal high table water		USDA texture
	Feet	*Feet*	*Inches*	
*Lanton: La, Ld	5	[3] 0–1½	0–72	Silty clay loam
For Verdigris part of Ld, see Verdigris series.				
Lebanon: LeB	5	1½–2½	0–6	Silty loam
			6–22	Silty clay loam
			22–38	Very cherty silty clay loam (fragipan).
			38–73	Cherty silty clay
*Liberal: LlB, LmC2, LoD	3½	1–2½	0–7	Silty loam
			7–16	Silty clay loam
			16–43	Clay
Mine pits and dumps: Mp. Properties too variable to be estimated.				
Newtonia: NeB	5	5	0–15	Silty loam
			15–40	Silty clay loam
			40–72	Cherty silty clay
Nixa: NhC	5	1½–2½	0–4	Cherty silty loam
			4–29	Very cherty silty loam
			29–52	Very cherty silty loam (fragipan).
			52–72	Very cherty silty loam
Parsons: PaA, PaB, PaB2	6	[2] 1–1½	0–14	Silty loam
			14–26	Clay
			26–69	Silty clay loam
*Radley: Rv	5	[3] 1½–3	0–72	Silty loam
For Verdigris part, see Verdigris series.				
Summit: SuA, SuB	4	1–3	0–13	Silty clay loam
			13–23	Silty clay
			23–57	Silty clay loam
Verdigris	5	[3] 3–5	0–31	Silty loam
Mapped only in undifferentiated groups with Lanton soils and with Radley soils.			31–72	Loam

[1] The pH value of soil in water (1:1) was determined with a glass electrode.
[2] Seasonal perched water table.

significant to engineering—Continued

Classification—Continued		Percentage passing sieve—			Reaction [1]	Permeability	Available water capacity	Shrink-swell potential
Unified	AASHO	No.4 (4.7 mm.)	No.10 (2.0 mm.)	No.200 (0.074 mm.)				
					pH	*Inches per hour*	*Inches per inch of soil*	
CL or CH	A-6 or A-7	100	100	95-99	6. 1-7. 3	0. 06-0. 2	0. 16-0. 19	Moderate.
ML	A-4	100	100	83-91	4. 5-5. 5	0. 6-2. 0	0. 18-0. 22	Low.
CL	A-7-6	100	100	86-91	4. 0-5. 0	0. 6-2. 0	0. 16-0. 19	Moderate.
SC, GC or CL	A-4	72-77	49-63	45-56	4. 0-5. 0	<0. 06	0. 05	Low.
CH	A-7-5	78-93	67-87	61-71	4. 5-6. 5	0. 06-0. 2	0. 06-0. 08	Moderate to high.
ML-CL	A-4	100	96-99	80-92	4. 5-5. 5	0. 6-2. 0	0. 19-0. 21	Low to moderate.
CL	A-6 or A-7	100	97-99	87-97	4. 5-5. 5	0. 2-0. 6	0. 16-0. 18	Moderate to high.
CH	A-7-6	100	97-99	78-91	4. 5-5. 5	0. 06-0. 2	0. 08-0. 13	High.
ML-CL	A-4	100	100	91-93	5. 1-6. 0	0. 6-2. 0	0. 14-0. 20	Low.
ML-CL	A-7-6	100	100	91-94	4. 5-6. 0	0. 6-2. 0	0. 16-0. 18	Moderate.
MH-CH	A-7-5	86-99	84-98	84-94	4. 5-6. 0	0. 6-2. 0	0. 11-0. 13	Moderate tohigh.
ML	A-4	66-85	63-75	50-65	5. 1-6. 0	0. 6-2. 0	0. 13-0. 15	Low.
GM or ML	A-4	45-60	41-59	36-55	4. 5-5. 5	0. 6-2. 0	0. 10-0. 13	Low.
GM	A-2-4	35-50	30-40	20-35	4. 0-5. 0	<0. 06	0. 05	Low.
GM or CL	A-4	50-64	44-63	39-59	4. 5-5. 0	0. 2-0. 6	0. 10-0. 13	Low.
ML or ML-CL	A-4 or A-6	100	100	83-89	4. 5-6. 0	0. 6-2. 0	0. 19-0. 22	Low.
CH	A-7-6	100	100	90-95	4. 5-5. 5	<0. 06	0. 09-0. 12	High.
CL	A-6 or A-7-6	100	100	87-90	5. 1-6. 0	0. 2-0. 6	0. 16-0. 18	High.
ML	A-4	100	100	90-98	5. 6-7. 3	0. 6-2. 0	0. 19-0. 23	Low.
CL	A-6 or A-7	100	100	92-97	5. 6-6. 5	0. 2-0. 6	0. 16-0. 18	Moderate.
CH	A-7-5	100	96-99	89-95	6. 1-7. 3	0. 06-0. 2	0. 11-0. 13	High.
CH or CL	A-7	100	95-99	88-94	6. 1-7. 8	0. 2-0. 6	0. 16-0. 17	High.
ML	A-4	100	100	89-98	5. 6-6. 5	0. 6-2. 0	0. 19-0. 23	Low.
ML	A-4	100	100	88-96	6. 1-6. 5	0. 6-2. 0	0. 18-0. 22	Low.

[3] Subject to flooding.

TABLE 7.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Suitability as a source of—		Soil features affecting—			
					Farm ponds	
	Topsoil	Road fill	Highway location	Dikes and levees	Reservoir areas	Embankments
Askew: AkB, AsB, AsB2	Good	Fair: traffic-supporting capacity.	Moderate shrink-swell potential; receives runoff and seepage in places.	Fair to poor stability; moderate shrink-swell potential.	Moderate permeability.	([1])
Barco: BaB, BaB2, BcB, BcB2.	Good	Fair: thickness of suitable material.	Some lateral seepage; sandstone at depth of 20 to 40 inches.	Not applicable	Moderate permeability; sandstone at depth of 20 to 40 inches.	Thin lenses of clay shale interbedded with sandstone; limited borrow material.
Barden: BdB, BdB2	Good	Fair: high to moderate shrink-swell potential.	High to moderate shrink-swell potential; receives runoff and seepage in places.	Not applicable	Slow permeability.	([1])
Bolivar: BoB, BoB2	Good	Fair: thickness of suitable material.	Some lateral seepage; sandstone at depth of 20 to 40 inches.	Not applicable	Moderate permeability; sandstone at depth of 20 to 40 inches.	Thin lenses of clay shale interbedded with sandstone; limited borrow material.
Breaks-Alluvial land complex: Br. No interpretations; properties too variable.						
Bronaugh: BsB	Fair: 15 inches of suitable material.	Fair: moderate to high shrink-swell potential.	Moderate to high shrink-swell potential.	Not applicable	Moderately rapid permeability.	Moderate to high shrink-swell potential.
Carytown: Ca [2]	Poor: poorly drained.	Poor: high shrink-swell potential; high content of sodium.	Seasonal perched water table; high content of sodium; high shrink-swell potential; receives runoff and seepage in places.	Poor stability; high shrink-swell potential; high content of sodium.	Very slow permeability.	High shrink-swell potential; high content of sodium.

See footnotes at end of table.

engineering properties

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Soil features affecting—Continued					Degree and kind of limitations for sewage disposal	
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tanks	Lagoons
Moderately well drained; moderate permeability; receives runoff and seepage in places.	Gently sloping; high available water capacity.	No adverse features.	No adverse features.	Moderate: shrink-swell potential.	Moderate: seasonal high water table at depth of 1½ to 3 feet.	Moderate: moderate permeability.
Not applicable----	Gently sloping; sandstone at depth of 20 to 40 inches. BaB, BaB2, BcB2: low available water capacity. BcB: moderate available water capacity.	Erodible; sandstone at depth of 20 to 40 inches; common knobs and saddles on landscape.	Erodible; sandstone at depth of 20 to 40 inches.	Moderate shrink-swell potential.	Moderate to severe: sandstone at depth of 20 to 40 inches.	Moderate: sandstone at depth of 20 to 40 inches; some lateral seepage; thin lenses of clay shale interbedded with sandstone.
Moderately well drained; slow permeability; receives runoff and seepage in places.	Gently sloping. BdB: high available water capacity. BdB2: moderate available water capacity.	No adverse features.	No adverse features.	Moderate to high shrink-swell potential.	Severe to moderate: slow permeability.	Slight.
Not applicable----	Gently sloping; sandstone at depth of 20 to 40 inches; low available water capacity.	Erodible; sandstone at depth of 20 to 40 inches.	Erodible; sandstone at depth of 20 to 40 inches.	No adverse features.	Moderate to severe: sandstone at depth of 20 to 40 inches.	Moderate: sandstone at depth of 20 to 40 inches; thin lenses of clay shale interbedded with sandstone.
Not applicable----	Gently sloping; high available water capacity.	Landscape is mostly knobs.	No adverse features.	Moderate to high shrink-swell potential.	Slight----------	Severe: moderately rapid permeability; moderate to high shrink-swell potential.
Poorly drained; flat and ponded in some places.	Flat and ponded in some places; very poor internal drainage; high content of sodium; moderate available water capacity.	Nearly level; clay at a depth of 4 to 20 inches; very slow permeability.	Clay at a depth of 4 to 20 inches; high content of sodium; difficult to vegetate.	High shrink-swell potential; high content of sodium; very slow permeability; common slickensides.	Severe: very slow permeability; seasonal perched water table.	Slight.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—			
	Topsoil	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas	Farm ponds: Embankments
Cherokee: Ce	Good	Poor: high shrink-swell potential.	Seasonal perched water table; high shrink-swell potential; receives runoff and seepage in places.	Poor stability; high shrink-swell potential.	Very slow permeability.	(1)
Cleora: Cf	Good	Good	Frequent flooding.	Fair to poor stability; low shrink-swell potential.	Moderately rapid permeability; frequent flooding.	Susceptible to piping.
Collinsville: CoB CoD, CrD.	Poor [1]	Poor: thickness of suitable material.	Gently sloping to moderately steep; shallow to sandstone.	Not applicable	Moderately rapid permeability; shallow to sandstone.	Thin lenses of clay shale interbedded with sandstone; limited borrow material.
Creldon: CsB, CsB2, CtB.	Good	Fair: moderate to high shrink-swell potential.	Moderate to high shrink-swell potential.	Not applicable	Fragipan at moderate depth; permeability moderate above fragipan but slow through fragipan.	No adverse features.
Hector: HcB, HcD, HeD, HeE.	Poor [1]	Poor: thickness of suitable material.	Gently sloping to steep; shallow to sandstone.	Not applicable	Rapid permeability; shallow to sandstone.	Thin lenses of clay shale interbedded with sandstone; limited borrow material.
*Hepler: Hm, Hp, Hr. For Radley part of Hr, see Radley series.	Good	Fair: traffic-supporting capacity.	Occasional flooding; seasonal high water table.	Fair to poor stability; subject to frost heave; moderate shrink-swell potential.	Moderately slow permeability; occasional flooding; some ponding.	Medium to low shear strength.
Keeno: KeC, KnC	Poor: coarse fragments.	Fair: moderate traffic-supporting capacity.	Moderate traffic-supporting capacity.	Not applicable	Moderate depth to fragipan; permeability moderate above fragipan, but slow through fragipan.	Some seepage; suitable borrow material limited.
*Lanton: La, Ld. For Verdigris part of Ld, see Verdigris series.	Good	Fair: moderate to high shrink-swell potential.	Occasional or frequent flooding; seasonal high water table.	Fair stability; moderate to high shrink-swell potential.	Slow permeability; occasional or frequent flooding.	No adverse features.

See footnotes at end of table.

engineering properties—Continued

Soil features affecting—Continued					Degree and kind of limitations for sewage disposal	
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tanks	Lagoons
Somewhat poorly drained; flat ponded spots in some places.	Flat and ponded in some places; poor internal drainage; high available water capacity.	Nearly level; very slow permeability; high clay accumulation at a depth of 6 to 30 inches.	Nearly level; clay at a depth of 6 to 20 inches; difficult to vegetate.	High-shrink-swell potential; very slow permeability.	Severe: very slow permeability; seasonal perched water table.	Slight.
Well drained; frequent flooding.	Frequent flooding; moderate available water capacity.	Not applicable	Frequent flooding.	Low shrink-swell potential; frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.
Not applicable	Gently sloping; nonstony; shallow to sandstone; very low available water capacity.	Shallow to sandstone. CoD: stony.	Shallow to sandstone. CrD: stony.	Bedrock at a depth of less than 20 inches.	Severe: shallow to sandstone.	Severe: shallow to sandstone; thin lenses of clay shale interbedded with sandstone; slope.
Not applicable	Gently sloping; root depth limited by fragipan. CsB, CtB: high available water capacity. CsB2: low available water capacity.	No adverse features.	No adverse features.	Moderate to high shrink-swell potential.	Severe: slow permeability through fragipan.	Slight.
Not applicable	Gently sloping: nonstony; shallow to sandstone; very low available water capacity.	Shallow to sandstone. HeD, HeE: stony.	Shallow to sandstone. HeD, HeE: stony.	Bedrock at a depth of less than 20 inches.	Severe: shallow to sandstone.	Severe: shallow to sandstone; thin lenses of clay shale interbedded with sandstone; slope.
Somewhat poorly drained; occasional flooding; seasonal ponding in places; good outlets.	Nearly level; seasonal high water table; high available water capacity.	Not applicable	Occasional flooding; seasonal high water table.	Occasional flooding; moderate shrink-swell potential.	Severe: moderately slow permeability; flooding; seasonal high water table.	Severe: flooding.
Not applicable	Gently sloping to sloping; rooting depth limited by fragipan; low available water capacity.	Sloping or stony in some places; slow permeability through fragipan.	Sloping, cherty, or stony soils in some places.	Seasonal high water table.	Severe: slow permeability through the fragipan.	Moderate: coarse fragments.
Poorly drained; frequent flooding; seasonal ponding; good outlets.	Nearly level; occasional or frequent flooding; seasonal high water table; high available water capacity.	Not applicable	Occasional or frequent flooding; seasonal high water table.	Occasional or frequent flooding; moderate to high shrink-swell potential.	Severe: occasional flooding; seasonal high water table; slow permeability.	Severe: flooding.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—			
	Topsoil	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas	Farm ponds: Embankments
Lebanon: LeB	Good	Fair: shrink-swell potential.	No adverse features.	Not applicable	Moderate depth to fragipan; permeability moderate above fragipan but slow through fragipan.	No adverse features.
*Liberal: LlB, LmC2, LoD. For Collinsville and Barco parts of LoD, see those series.	Good	Poor: moderate depth to shale; high shrink-swell potential.	Gently sloping to sloping; shale at a moderate depth; some lateral seepage; high shrink-swell potential.	Not applicable	Slow permeability; shale at a moderate depth.	Borrow material limited; high shrink-swell potential.
Mine pits and dumps: Mp. No interpretations; properties too variable.						
Newtonia: NeB	Good	Fair: traffic-supporting capacity.	Moderate traffic-supporting capacity.	Not applicable	Moderate permeability; low volume of runoff.	Low to moderate shrink-swell potential; seepage.
Nixa: NhC	Poor: coarse fragments.	Fair: wetness	Moderately well drained.	Not applicable	Moderate depth to fragipan; very slow permeability.	Some seepage; suitable borrow material limited.
Parsons: PaA, PaB, PaB2.	Fair: 14 inches of suitable material.	Poor: high shrink-swell potential.	Seasonal perched water table; high shrink-swell potential.	Not applicable	Very slow permeability.	High shrink-swell potential.
*Radley: Rv. For Verdigris part, see Verdigris series.	Good	Fair: traffic-supporting capacity.	Frequent flooding.	No adverse features.	Moderate permeability; frequent flooding.	Fair to poor compaction characteristic.

See footnotes at end of table.

engineering properties—Continued

Soil features affecting—Continued					Degree and kind of limitations for sewage disposal	
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tanks	Lagoons
Not applicable	Gently sloping; rooting depth limited by fragipan; moderate available water capacity.	No adverse features.	No adverse features.	Seasonal high water table.	Severe: slow permeability through fragipan.	Slight.
Moderately well drained; moderately deep to shale; some seepy spots.	Gently sloping to sloping; shale at a moderate depth. LlB, LoD: moderate available water capacity. LmC2: low available water capacity.	Erodible; shale at a moderate depth; many knobs and saddles in landscape.	Erodible; shale at a moderate depth; difficult to vegetate.	Shale at a moderate depth; high shrink-swell potential; few slickensides.	Severe: slow permeability; shale at a moderate depth.	Severe: depth to bedrock.
Not applicable	Gently sloping; high available water capacity.	No adverse features.	No adverse features.	Moderate shrink-swell potential.	Slight	Severe: low to moderate shrink-swell potential; seepage; moderate permeability.
Not applicable	Gently sloping to sloping; stony in places; rooting depth limited by fragipan; low available water capacity.	Sloping; cherty soils in some places; very slow permeability through fragipan.	Sloping in some places; cherty soils.	Seasonal high water table.	Severe: very slow permeability.	Moderate: coarse fragments.
Somewhat poorly drained; flat, ponded spots in some places.	Gently sloping or nearly level; a few flat, ponded spots; poor internal drainage. PaA, PaB: high available water capacity. PaB2: moderate available water capacity.	Nearly level in most places; clay at a depth of 6 to 16 inches; very slow permeability.	Nearly level in most places; clay at a depth of 6 to 16 inches; difficult to vegetate.	High shrink-swell potential; very slow permeability.	Severe: very slow permeability; seasonal perched water table.	Slight.
Moderately well drained frequent flooding.	Nearly level; frequent flooding; very high available water capacity.	Not applicable	Frequent flooding.	Low shrink-swell potential; frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of— Topsoil	Road fill	Soil features affecting— Highway location	Dikes and levees	Farm ponds: Reservoir areas	Embankments
Summit: SuA, SuB	Fair: 13 inches of suitable material.	Poor: high shrink-swell potential.	Receives run-off and seepage in places; high shrink-swell potential; few slickensides.	Fair to poor stability; high shrink-swell potential; few slickensides.	Slow permeability.	High shrink-swell potential.
Verdigris: Mapped only in undifferentiated groups with Lanton soils and with Radley soils.	Good	Fair: traffic-supporting capacity.	Frequent flooding.	No adverse features.	Moderate permeability.	Fair to poor compaction characteristic.

[1] Revegetation and erosion control of borrow area are major problems. Some areas are stony.

TABLE 8.—*Engineering*

[Test performed by Missouri State Highway Commission,

Soil name and location	Parent material	Missouri report No.	Depth	Moisture density [1]: Maximum dry density	Optimum moisture
			Inches	*Lb. per cu. ft.*	*Percent*
Carytown silt loam: 875 feet east and 405 feet south of the NE. corner of sec. 19, T. 31 N., R. 29 W. (Modal profile.)	Shale, old alluvium or colluvium, or loess, or mixed.	66–21444	0–9	108	15
		66–21445	25–36	93	26
		66–21446	48–72	107	19
Creldon silt loam, deep: 2,550 feet south and 920 feet west of the NE. corner of sec. 34, T. 31 N., R. 29 W. (Finer textured in B horizon than modal profile.)	Loess over cherty limestone residuum.	66–21450	0–11	108	15
		66–21451	23–31	99	22
		66–21452	31–44	105	21
		66–21453	44–72	87	30
Hepler silt loam: 1,290 feet west and 250 feet north of the SE. corner of sec. 4, T. 31 N., R. 29 W. (Modal profile.)	Silty alluvium.	66–21454	7–20	108	17
		66–21455	30–48	106	19

[1] Based on AASHO Designation T 99-57, Method C (*1*).

[2] Mechanical analyses according to the American Association of State Highway Officials Designation T 88-57 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the

engineering properties—Continued

Soil features affecting—Continued					Degree and kind of limitations for sewage disposal	
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tanks	Lagoons
Moderately well drained; slow permeability; receives runoff and seepage in some places.	Gently sloping and nearly level, sloping in some places; high available water capacity.	No adverse features.	No adverse features.	High shrink-swell potential.	Severe: slow permeability.	Slight.
Well drained; frequent flooding.	Nearly level; frequent flooding; high available water capacity.	Not applicable__	Frequent flooding.	Low shrink-swell po-potential; frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.

[2] Below a depth of 25 inches, salts affect properties of the soils of the Carytown series.

test data

Division of Materials and Research, Jefferson City]

Mechanical analysis [2]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—					AASHO [3]	Unified [4]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
100	99	97	84	76	15	8	25	3	A-4(8)	ML
100	96	95	89	88	62	57	69	45	A-7-6(20)	CH
------------	100	98	86	82	48	40	54	35	A-7-6(19)	CH
100	100	95	81	73	17	11	26	4	A-4(8)	ML
88	99	98	88	83	54	46	47	25	A-7-6(15)	CL
96	85	81	71	67	41	37	46	25	A-7-6(14)	CL
------------	96	94	88	88	79	74	97	64	A-7-5(20)	CH
------------	100	98	93	88	33	20	27	8	A-4(8)	CL
------------	100	98	87	83	44	36	38	21	A-6(12)	CL

fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-sized fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[3] Based on AASHO Designation M 145-49 (*1*).

[4] Based on the Unified Soil Classification System (*12*).

Estimated soil properties significant to engineering

Estimated soil properties significant to engineering are shown in table 6. They are based on field descriptions and classification, on physical and chemical tests of the individual soils made by members of the survey party, and on test data from the same or similar soils in the county and nearby areas. Although this information is generalized for a given soil, it is the best available estimate of the soil properties of that soil. Because a soil varies from place to place, it is likely that the soil properties will vary accordingly. Most mapping units also include a small percentage of contrasting soils.

USDA texture is determined by the relative proportions of sand, silt, and clay in the fine earth fraction of a soil. The fine earth fraction consists of soil particles that are less than 2.0 millimeters in diameter. Sand, silt, and clay, as used here, are defined in the Glossary of this survey.

Reaction refers to the pH value of the soil. A value of 7.0 indicates precise neutrality. Lower values indicate increasing acidity, and higher values indicate increasing alkalinity.

Permeability, as used in table 6, is the rate at which water moves downward through undisturbed and uncompacted soil. Lateral seepage is not considered. The estimates of permeability were obtained by comparing the soil with soils of known permeability or by using the common range in permeability of soils of a given texture. Plowpans, trafficpans, surface crusts, and other properties resulting from use were not considered.

Available water capacity is the amount of water available to plants after all free water has drained away. This water is held in the range between field capacity of the soil and the permanent wilting point of common crops. The available water capacity class for each soil series, based on the total inches of water in the upper 60 inches of soil, is shown in the section "Descriptions of the Soils." The classes are *very high*, more than 12 inches; *high*, 9 to 12 inches; *moderate*, 6 to 9 inches; *low*, 3 to 6 inches; and *very low*, less than 3 inches.

Shrink-swell potential is an indication of the volume change to be expected with a change in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. The estimates are based, for the most part, on the normal shrink-swell potential for given soil textures.

Interpretations of engineering properties

Table 7 includes special information that is useful to engineers, conservationists, and others who plan the use of soil material in the construction of roads, buildings, sewage disposal systems, soil and water conservation structures, and other farm facilities. The information in this table is based on the estimated engineering properties of the soils in table 6, on available test data, and on field experience.

Topsoil is fertile soil or soil material, ordinarily rich in organic matter, that is used to topdress lawns, gardens, cuts, fills, road banks, and the like.

Road fill ratings are based on the performance of soil material borrowed and used for modern concrete pavement and blacktop highway subgrades and embankments.

Soil features listed under "Highway location" gives the planning engineer information that is useful in choosing highway routes. Entire soil profiles, except for organic surface layers, are evaluated. They are based on the soil in place, undisturbed, and without artificial drainage.

Dikes and levees are low-height, low-hazard embankments. Features given are properties of the soils, or the conditions present at the site, that influence behavior of the soil when used for these purposes.

Reservoir areas for farm ponds are the areas in which water is impounded. Features that affect the rate at which impounded waters enter, percolate down, or seep laterally through the soil are indicated.

Farm pond embankments are earthen embankments that are constructed from borrowed soil materials. The subsoil and underlying material are both considered.

Listed under "Agricultural drainage" are natural drainage and other features of the soil, as well as conditions at the site, that affect agricultural drainage.

Considered under "Irrigation" are slope gradient, available water capacity, site conditions, and other features of the soil affecting irrigation.

Terraces, diversions, and grassed waterways constructed from soil materials are used to control water and to protect soil from erosion. Landscape characteristics, susceptibility to erosion, depth to bedrock, and unfavorable soil layers are some of the soil features considered.

Considered under "Foundations for low buildings" are features of the undisturbed soil that affect its suitability for supporting such structures under normal conditions.

Table 7 also gives the degree and kinds of limitations that affect use of the soil for disposing of sewage. Considered under "Septic tanks" are those features of the undisturbed soil that limit the ability of the soil to filter or absorb the outflow from septic tanks or that, in some other way, make the soil hazardous to use for this purpose. Under "Sewage lagoons" the undisturbed soil is rated according to its capacity to hold sewage for the time necessary for bacterial decomposition.

Engineering test data

The data given in table 8 show the results of tests made by the Missouri State Highway Commission under a cooperative agreement with the Soil Conservation Service. Results of the tests help to evaluate the soils for engineering purposes. The tests were made in accordance with standard procedures.

The engineering soil classifications given in table 8 are based on data obtained by mechanical analysis and on the results made to determine the liquid limit and plasticity index of the soils tested. Mechanical analyses were made by combined sieve and hydrometer methods.

Table 8 gives moisture-density data for the tested soils. Moisture-density data are important in earthwork, for as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Tests for liquid limit and plastic limit measure the effects of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid

to a plastic. As the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic. The liquid limit is the moisture content at which the material passes from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Formation and Classification of the Soils

This section tells how the factors of soil formation have affected the development of soils in Barton County. It also explains the system of soil classification and places the soil series in some of the higher categories of this classification.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determine it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is "the unconsolidated and more or less chemically weathered mineral material from which soils may be synthesized (*2*). For the most part, parent material in Barton County consists of material weathered in place from bedrock. Because it is still at the original site, this material is called residuum. In many places, especially on high, wide divides, a thin mantle of loess, or windblown silty material, covered the residuum. Sediments washed from the nearby uplands were deposited on the flood plain of streams. These deposits make up the relatively small part of the parent materials that were transported.

Rocks of Pennsylvania age underlie 93 percent of the surficial deposits in Barton County. These rocks formerly covered the entire county, as evidenced by the scattered outliers of the system that occur on the Springfield Plain, southeast of the Pennsylvanian crop line. The area north and west of this line is known as the Cherokee Plain (*3*). Nearly all of the Pennsylvania strata in Barton County are assigned to the Cherokee Group of the Desmoinesian Series (*4*). Only one small outcrop, 6 miles north of Iantha, and another, 1 mile northwest of Verdella, are in the Marmaton Group. These outcrops are outliers of the wide Warrensburg Plain to the north. Limestone members of the formations in the Marmaton Group are thin and limited in extent. Because limestone is scarce in this part of the county, these outcrops have some potential for flagstone and road metal.

The Cherokee Group comprises all of the strata included in the Krebs and Cabanis Subgroups. The time of deposition includes all of the Veteran age and the early part of the Cygnian age. The Cherokee Group is made up of sandstone, siltstone, shale, clay, limestone, and coalbeds. The limestone members are few, thin, and in places, nonexistent. A coalbed is at the top of most. From the base upward, the Rowe, Drywood, and Bluejacket Formations of the Krebs Subgroup are extensive and important in Barton County. Most of the fine sandy loam soils of the Barco, Bolivar, Collinsville, and Hector series formed in sandstone residuum from the Bluejacket and Rowe Formations. The coal in the Rowe Formation has been mined in many places. Most of the Bluejacket Formation contains asphaltic residue. All members of the Drywood Formation are exposed in the county. Most of the silt loam soils of the Parsons and Barden series formed in residuum weathered from the siltstone, shale, and clay members of the Drywood and Weir Formations. The Weir is the most important and extensive formation in the Cabanis Subgroup in Barton County. The Weir-Pittsburg coal has been exploited. This is evidenced by about 12,000 acres of Mine pits and dumps that lie in an almost continuous area near the Kansas line from Mindenmines northward.

Older rocks of Mississippian age underlie the Springfield Plain in the southeastern part of the county and make up 7 percent of it. The presence of the Warsaw and St. Louis Formations has been established, but the presence of the Salem Formation is only tentatively recognized. These formations are in the Meramecian Series. Limestone members dominate these formations, although thin chert and shale members are included. These formations are quarried for agstone and road metal. Soils of the Keeno and Nixa series formed in cherty limestone and are cherty throughout their depth. Newtonia and Summit soils are nearly chert free. The Creldon and Lebanon soils also are relatively chert free above the fragipan that occurs at a depth of 20 to 30 inches.

The characteristics of the soils of Barton County have been profoundly influenced by the parent material. In many places soil and parent material are very similar in texture, structure, and chemical and mineralogical composition. The young, shallow, sandstone-derived Collinsville and Hector soils are good examples. Another

example is the soils that formed in recent stream deposits, such as soils of the Radley, Verdigris, and Cleora series. Other examples are the Carytown soils, which are high in sodium, and the high-in-calcium, fertile, limestone-derived soils of the Summit series. In all of these examples, the kind and nature of the parent material greatly influenced the character of the soils that were formed. The climatic forces, as well as most of the other factors, were held in check by time and the resistance of the parent material to weathering.

Plant and animal life

Many kinds of organisms live in the soil. Both plants and animals are abundant. They range in size from tiny bacteria to large rodents. Plants, micro-organisms, animals, and man have all had a decided effect on soil formation in Barton County. The residue of plant and animal life is called organic matter. It consists of the original plant or animal tissue, partially decomposed parts, and humus. Humus is the part that is resistent to further decomposition, is black or brown in color, and is colloidal in nature. It has a capacity to hold water and supply nutrients to plants that exceeds clay, its inorganic counterpart. The presence of humus increases granulation and improves tilth. The lightness of color in a soil, especially the surface layer, is determined by the kind and quantity of organic matter it contains. The nitrogen supply and natural fertility of a soil are directly related to its organic-matter content.

It is probable that climatic conditions favorable for the growth of trees prevailed during the time the soils formed. When only the American Indian lived in this area, however, a lush native vegetation of tall prairie grasses covered most of the region. Deciduous trees bordered the major streams and covered about 10 percent of the land. Both native prairie and forest modify climatic influences. The rooting habits and mineral composition of tall prairie grasses and deciduous trees are quite different, and there is a marked difference between the micro-organisms and animals that are associated with each. Other factors being equal, a soil formed under grass is profoundly different from a soil formed under trees.

Under trees the accumulating organic matter is mixed with the upper part of the surface layer, which is no more than 6 inches and is dominantly less than 4 inches in thickness. A thicker, leached, lighter colored subsurface layer that is brown, yellowish brown, or grayish brown and has platy structure is formed. The subsoil is brighter colored, finer textured, and has blocky structure. Nitrogen, fertility, and organic-matter content are relatively low. These soils are commonly called light-colored timber soils and are in the Askew, Bolivar, Hector, Lebanon, and Nixa series.

The remaining soils in the county formed under grass or a mixture of grass and trees. Under grass the rate of organic-matter accumulation is higher and the amount is greater than it is under trees. The organic matter is thoroughly mixed with the loamy, mineral surface material. The resulting thick, dark-colored surface layer has granular structure. Organic stains and films partially or completely coat the blocky structural aggregates that form the subsoil. In most places the subsoil is finer textured than the surface layer. The dark color extends to a depth of about 6 inches in eroded soils of the Barden and Barco series and to a depth of more than 24 inches in the soils of the Verdigris and Lanton series. Nitrogen, organic-matter content, and natural fertility range from medium to high. Locally, this large group of soils is called dark-colored prairie soils. They were free of trees and, except for having the sod broken, ready for cultivation when man arrived on the scene.

Micro-organisms reduced both raw and partially decomposed organic matter to humus. The plant nutrients released in this process and the atmospheric nitrogen fixed by nodule bacteria are examples of how they beneficially affected the growth of higher plants. Thus, it is evident that micro-organisms directly and indirectly affect soil formation. The kind and population vary according to the type of organic matter and to the air and water relationships present at a particular place. Bacteria and fungi contribute more to soil formation than other micro-organisms.

Earthworms, insects, and burrowing animals have a favorable effect on tilth, fertility, and drainage. Plentiful or abundant earthworm channels and casts are distinctive features of many soils in the county. Soils of the Barco, Bolivar, and Newtonia series under grass, trees, and cultivation respectively, are prime examples.

The higher animals, including man, have had a disturbing influence on soil formation in Barton County. Today, man has had a greatly modifying effect on the soil-forming factors. He uses huge, efficient machines to till the soil. Improved varieties of grain and forage are grown. Liberal applications of chemicals are used to fertilize the desirable higher plants and to control the undesirable plants, insects, and pests. A small but increasing acreage is irrigated. Improvements such as these will continue, probably at an accelerated rate. Accelerated erosion is on the increase and will continue unless adequate control measures are used. Plans have been made to strip the original mantle of soil over the coalbeds and remove the coal from many more acres. More than 12,000 acres of soils have been destroyed in this manner. Up to this time, the net effects of man on soil formation have been adverse. This trend will probably continue, but it could be reversed.

Climate

Barton County has a temperate, humid, continental climate. The average annual precipitation is 40 inches, and the frost-free growing season in 194 days. Generally, the prevailing winds are warm, moist, and from the south or southwest. During most years, however, from the middle of July to the first of September, these winds are hot and dry and rainfall is limited. Short periods of excessive rainfall in spring or fall, or both, are common. In winter the soils are frozen for short periods, and the factors influencing soil formation are slowed down or inactive. Soil temperature, in most places, averages slightly more than 59° F. at a depth of 20 inches below the surface.

Favorable temperature and rainfall have encouraged rapid chemical changes at the expense of physical disintegration. These conditions have also provided a favorable environment for the growth of deciduous trees. Consequently, the reason why the native vegetation, for the

most part, was tall grass prairie is not known. Nitrogen, organic-matter content, and fertility are medium to high under grass, but they are low under trees. Although calcium carbonate and other salts soluble in water have been removed by leaching, most of the soils are medium in natural fertility. Nitrogen, organic-matter content, and fertility range from high in the Lanton and Summit soils to low in the Hector and Nixa soils.

Nearly all of the soils have a considerable amount of exchangeable calcium. Accumulations of silica-rich clay occur just below the leached, medium acid surface layer. They are colloidal in nature and contain much iron and aluminum. A mineral soil, especially the part below the surface layer, gets most of its color from iron. Under conditions of good drainage, oxidized forms of iron are abundant. Uniform red or reddish-brown color, as in the soils of the Newtonia and Bronaugh series, are most common. Hydrated forms give rise to yellowish brown and other more subdued shades. Soils of the Askew and Barden series are examples. Layers of soils that are frequently saturated or saturated with water for a long time are gray. This is because of the presence of reduced forms or a small total amount of iron. Good examples are soils of the Hepler series.

The presence of prominent layers of any kind in a soil indicates that chemical weathering has been intense. The well-developed, extremely acid, firm fragipans in the soils of the Creldon, Keeno, Lebanon, and Nixa series are examples. Other good examples are the bleached subsurface layer and very clayey subsoil in the soils of the Parsons, Cherokee, and Carytown series.

Thus, we see that climate greatly influenced the nature of the weathering. It probably did not exercise a full measure of control over the native vegetation. Even so, the kind and character of the soils in the county, in the time they have been developing, indicate that climate has played the dominant role in soil formation.

Relief

The dip of the underlying bedrock and the general slope in Barton County is from southeast to northwest. The elevation above sea level averages from 900 to 1,000 feet. The local variation in relief is less than 150 feet (*7*).

The topographic features of the county are controlled, to a marked degree, by the geologic structure and the relative resistance of the bedrock to weathering and erosion. Consequently, most of the soils over thick beds of shale, such as soils of the Cherokee series and most of the Parsons and Carytown series, are nearly level and have subnormal relief. Slopes are long and uniform in grade. Normal relief and shorter, somewhat broken and steeper slopes characterize the sandstone-derived soils of the Barco and Bolivar series. Also derived from sandstone are the sloping to steep soils of the Hector and Collinsville series. These soils have normal to excessive relief and include most of the rough and broken land along stream bottoms. Sandstone bedrock outcrops are common. Local variation in relief is the greatest along Horse and Dry Wood Creeks.

In areas of excessive relief, soil formation has been delayed. Erosion continually removes sand, silt, and clay particles as well as other parts of the soil. Surface runoff rapidly removes the excess water and thus reduces the percolation of water through the soil. Droughty conditions prevail in most places. Hence, the soil lacks adequate water for the vigorous growth of the plants that contribute most to soil formation. Areas of excessive relief are not so extensive or important as areas that have less relief.

Areas of subnormal relief are extensive and important in Barton County. Relief and drainage in these areas are better today than at an earlier time. During the days of soil formation, surface runoff was very slow or slow. Excess water saturated or kept the soil and parent material wet during much of the year. Erosion under native vegetation in a temperate, humid climate was almost nonexistent. In time the clay moved downward and accumulated below a strongly acid or extremely acid, leached surface layer. Subnormal relief hastened the normal process. A very considerable amount of clay was finally translocated. As a result prominent accumulations of dark clay abruptly underlie the bleached, severely leached, silty subsurface layer. The marked contrast in texture and color all but obscures the other properties of the soil. Soils of the Carytown, Cherokee, and Parsons series are good examples.

Most of the soils in Barton County formed in areas of normal relief. Climate and the other factors influencing soil formation were neither hastened or delayed. In addition to the Barco and Bolivar soils, the Barden, Bronaugh, Liberal, and Newtonia are good examples of mature soils that have developed in areas of normal relief.

Time

From the foregoing discussion it is evident that soil formation can be hastened or delayed. It should also be clear that some time is required to convert parent material to soil. A long time is required to produce a mature soil or change a young soil to an old one. The soils in Barton County range from very young to very old.

The young alluvial soils are exemplified by the Radley and Verdigris series. Soil particles washed from the nearby uplands are frequently deposited on the flood plains by the local streams. Erosion of part or all of the soil as it forms, excessive relief, and parent material that resists weathering account for the young, shallow soils on the uplands. Soils of the Collinsville and Hector series are examples. The difference between layers in these soils, especially the alluvial group, is not distinct or easily discernible.

Old age is reached when any layer develops to a point that it obscures the other properties of the soil. The high content of clay in the subsoil of the soils in the Parsons, Cherokee, and Carytown series is an example. How subnormal relief hastened the formation of this layer that has a high accumulation of clay is briefly discussed under "Relief" in this section.

Another good example is the prominent fragipan in soils of the Creldon, Keeno, Lebanon, and Nixa series. These are the oldest soils in the county. The extremely acid, firm fragipan underlies the present-day subsoil. This and the fact that finer textured layers are immediately above and below the fragipan indicate that this pan may be an erosional surface of a much older soil. That it formed during an earlier weathering cycle

seems probable. Thin clay films in the channels and cracks of the upper part of the soil, which probably was the surface layer of the older soil, reflect leaching of the present subsoil. Much thicker clay films and flows in the lower part of the soil are indicative of the movement of clay within the fragipan. This clay accumulation is probably the subsoil of the old soil.

Most of the remaining soils in the county have had time to mature. Their profiles reflect the conditions under which they formed. Time played an important part, but because the other factors were favorable, climatic influences tended to dominate.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (*6*, *9*). In table 9 the soil series of Barton County are placed in some categories of the current system.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. Most of the classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soils orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions, the Entisols and Histosols, occur in many different kinds of climate. There are four soil orders in Barton County—Inceptisols, Mollisols, Alfisols, and Ultisols.

Inceptisols are soils formed in relatively short periods of time, most often on young land surfaces. Layers of leaching or accumulation are not significant. In Barton County, layers are differentiated mostly by color and are readily discernible.

Mollisols have formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling.

Alfisols are mineral soils that contain horizons of clay accumulation. Unlike the Mollisols, they lack a thick, dark-colored surface layer that contains colloids dominated by bivalent cations, but the base saturation of the lower horizons is high.

Ultisols are mineral soils that contain horizons of clay accumulation. They have a thoroughly leached subsoil, and the base saturation of the lower horizons is low.

TABLE 9.—*Classification of soil series* [1]

Series	Family	Subgroup	Order
Askew	Fine-silty, mixed, thermic	Aquic Hapludalfs	Alfisols.
Barco	Fine-loamy, mixed, thermic	Mollic Hapludalfs	Alfisols.
Barden	Fine, mixed, thermic	Aquollic Hapludalfs	Alfisols.
Bolivar	Fine-loamy, mixed, thermic	Ultic Hapludalfs	Alfisols.
Bronaugh	Fine, mixed, thermic	Mollic Hapludalfs	Alfisols.
Carytown	Fine, mixed, thermic	Albic Natraqualfs	Alfisols.
Cherokee	Fine, mixed, thermic	Typic Albaqualfs	Alfisols.
Cleora [2]	Coarse-loamy, siliceous, thermic	Fluventic Hapludolls	Mollisols.
Collinsville	Loamy, mixed, thermic	Lithic Hapludolls	Mollisols.
Creldon	Fine, mixed, mesic	Mollic Fragiudalfs	Alfisols.
Hector	Loamy, siliceous, thermic	Lithic Dystrocrepts	Inceptisols.
Hepler	Fine-silty, mixed, thermic	Udollic Ochraqualfs	Alfisols.
Keeno	Loamy-skeletal, siliceous, mesic	Mollic Fragiudalfs	Alfisols.
Lanton	Fine-silty, mixed, noncalcareous	Cumulic Haplaquolls	Mollisols.
Lebanon	Fine, mixed, mesic	Typic Fragiudalfs	Alfisols.
Liberal	Fine, mixed, thermic	Aquollic Hapludalfs	Alfisols.
Newtonia	Fine-silty, mixed, thermic	Typic Paleudolls	Mollisols.
Nixa [3]	Loamy-skeletal, siliceous, mesic	Ochreptic Fragiudults	Ultisols.
Parsons	Fine, mixed, thermic	Mollic Albaqualfs	Alfisols.
Radley	Fine-silty, mixed, thermic	Fluventic Hapludolls	Mollisols.
Summit	Fine, montmorillonitic, thermic	Vertic Arguidolls	Mollisols.
Verdigris	Fine-silty, mixed, thermic	Cumulic Hapludolls	Mollisols.

[1] The classification used here is that of March 1967, as amended in July 1968 and April 1969.
[2] These soils are taxadjuncts to the Cleora series because they are strongly acid throughout the control section.
[3] These soils are taxadjuncts to the Nixa series because they have higher than typical base saturation below the fragipan.

SUBORDER: Each order has been subdivided into suborders, primarily on the basis of the characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP: Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

Additional Facts About the County

This section provides facts of interest about early settlement and population trends in Barton County and about relief and drainage, farming, communications, transportation, industry, cultural and recreational facilities, and climate.

Settlement and Population

Barton County was organized in 1857. It was formerly the northern part of Jasper County. Before it was organized, and for a short time afterwards, Osage and Sac Indians hunted over the area. Settlers moved in from time to time, grazed cattle, grew a few acres of corn, flax, and tobacco, and then moved on. Drovers grazed cattle in the area as they moved their herds from the south and west to markets in St. Joseph and Kansas City. In some years the cattle were wintered in the area.

Although the first settlers came to Barton County in about 1838, permanent settlement did not begin until 1860. The population increased slowly during the Civil War and for a number of years afterward. The generally peaceful Osage and Sac Indians were moved to reservations in the Oklahoma Territory.

Farming and surface strip mining of coal quickly became the two most important industries. Coal mining, like farming, stimulated the economy and brought people to the county. Trunklines to the coal fields to carry the coal to market were provided, and people came from far and near to work in the mines. By 1880 the population was 10,330. Many of the miners were emigrants from foreign countries, and Barton County became a melting pot. A population peak of 18,504 was reached in 1890.

Near the turn of the century, the cost of mining began to rise steadily and the demand for coal dropped because of competition from the oil and gas industries. Mines began to shut down, and unemployment and depression followed. Many people left the county. By 1910, the population of the county was 16,747. Mining continued to decline but remained an important industry until the great depression of the 1930's. Today coal mining is at a standstill. Mindenmines, Burgess, and other towns that were booming mining centers are now small, quiet towns or villages. Others have disappeared entirely. Recently a major plan has been undertaken to mine coal from Barton County and use it in an electric generating plant located in nearby Jasper County.

The population trend has been downward, beginning with the decline in coal mining. Farming is thriving, but fewer farmers are needed to produce more food. The trend is toward a smaller number of larger farms. Population in the county is likely to decrease for a few years and then stabilize at about 10,000 persons. Most of the children reared in the county move to cities to join the nation's labor force; however, the average age of farmers is decreasing.

Relief and Drainage

The surface features of Barton County are largely the result of water erosion and soil blowing. The landscape configurations differ from one area to another according to the geologic structure and relative resistence of the bedrock to weathering and erosion.

The tilt of the bedrock underlying the surficial deposits is from southeast to northwest. The general slopes of the surface is in the same direction. Elevation ranges from about 1,140 to 790 feet above sea level. The highest elevation is a point on the crest of a wooded divide about 2½ miles north of Golden City. The bottom of Dry Wood Creek at the Vernon County line is the low point. On many farms the total difference in local relief is less than 10 feet. On a few farms it is 20 feet to more than 30 feet.

Nearly level areas are extensive near the crest of the broad divide that separates the watersheds of the major streams. Other nearly level areas are the comparatively narrow flood plains of the major streams. Ridgetops, points, and side slopes are mostly gently sloping. Some of the side slopes are rolling but range to steep and broken near the major streams. The roughest areas in the county are the steep side slopes along Horse and Little Dry Wood Creeks. A few bedrock escarpments adjacent to the flood plains are precipitous. Most of the remaining land area which is the major part of the county, is gently sloping.

The East Fork and Middle Fork of Dry Wood Creek in the northwestern part, Little Dry Wood Creek in the

north-central part, and Horse Creek in the northeast corner drain the northern part of the county. They all flow northward through larger tributaries into the Osage River. Three forks of the Spring River drain the somewhat larger, southern part of the county. The North (Muddy) Fork of Spring River enters the county near Golden City and follows a northwesterly course to the vicinity of Lamar, where it turns southward. About 5 miles south of Lamar, North (Muddy) Fork is joined first by Pettis Creek on the east and then by a large tributary from the west. The main stem of the North Fork of Spring River begins at this point and carries away all the runoff waters from the south-central and southeastern parts of the county. The Little North Fork drains the southwestern part of the county. All of these waters eventually reach the Mississippi River. The drainage to the north is by the Missouri River, and to the south by the Arkansas River.

Farming

Early settlers in Barton County settled in forested areas near the larger streams where game and water were plentiful. Timber was available for constructing shelters and fences and for fuel. Cattle and work animals grazed the nearby prairie lands. Corn, flax, and tobacco were cultivated, and meat animals were produced to supply the family needs. Most of the income was from the sale of cattle, hogs, horses, and mules.

Tall prairie grasses once covered the best-developed and most-prized cultivated farmland in the county. Cash-grain commercial farms are most common in the nearly level areas near the crest of the divide that separates the watersheds of the major streams. Large, efficient machinery is used to work the soils. The principal crops are soybeans, corn, wheat, and grain sorghums. The sale of grain, feed cattle and hogs, and dairy products provides the major part of the income.

Nearer the streams, somewhat broken and stronger slopes are dominant and the type of farming is more diversified. The same crops are grown, but small grain, grasses, and legumes make up a much larger share of the total production. Cattle, produced mostly on forage, are sold as feeders. Many farmers grow corn and grain sorghums to feed cattle and hogs raised for market. The sale of dairy products is also important. Large numbers of broilers are produced, and laying hens are kept on a few poultry farms. Wheat and soybeans are sold as cash grain. Although the acreage of native prairie diminishes each year, Barton County continues to produce and sell more prairie hay than any other county in Missouri.

Farming is, and always has been, the most important enterprise in Barton County. Deep wells that tap the ground water have been developed by the Barton County Public Water District. Water is now available to most farmers and others persons residing in rural areas. Similar wells are being developed and impoundments constructed to trap surface water for supplemental irrigation. The acreage of irrigated vegetables and field crops has increased, but further increase depends on the availability of an adequate water supply. Deep wells produce from about 200 gallons to more than 800 gallons of water per minute. Although few and far between, a number of favorable impoundment sites are available. Many farmers plant adapted varieties of grain and forage crops, and they use lime and fertilizer for high production. Each year more farmers are making greater use of chemicals for preventing plant diseases and for controlling weeds and insects. Many farmers are providing the necessary drainage and erosion control. A well-managed, intensive, highly specialized type of crop production is becoming commonplace.

Many acres of the deeper, better soils in the county remain uncultivated. Under good management that uses an intensive cropping system, higher production can be expected. Erosion control on the sloping soils on uplands is needed. More field terraces, cross-slope channels, contour cultivation, and other practices for conserving soil and water also are needed.

Draining the wet soils of the bottom land significantly increases the production of grain and forage. Flood control measures, properly planned and installed, also help to increase and stabilize production.

Good land use and the installation of needed soil and water conservation practices to protect and improve the soils generally increase production. This is particularly true if the kind and numbers of livestock are adjusted to assure good utilization of the increased production of grain and forage. Cash-grain farms can adequately support a larger number of cattle and hogs if more of the grain is diverted from other markets. Crop residues can be better utilized. On the shallow and moderately deep soils that are clear of trees, better use of the land can be made by planting a larger acreage of small grain, quality grasses, and legumes and by raising more dairy and beef cattle or sheep.

According to the 1964 Census of Agriculture, about 89.5 percent of the land area of Barton County is in farms. The size of the average farm is about 235 acres, and the total number of farms is 1,270. There are 228,201 acres of cropland and 103,630 acres of pasture and timber land. Study of the recently completed soil survey indicates that over 84 percent of the land in the county is suitable for cropland. There were 13,498 beef cows, 11,600 hogs, 3,871 dairy cows, and 1,400 sheep in Barton County at a particular time in the period 1964–69, according to Calvin G. Jones, Extension Director.

Communications, Transportation, and Industry

Weekly newspapers are published in Golden City, Liberal, and Lamar. There is one daily newspaper published in Lamar. Telephone service and electric power are readily available to both rural and city dwellers. Natural gass is available in Lamar. Radio and television reception is excellent in all parts of the county. Stations in nearby towns of adjoining counties provide good radio and television services.

The transportation facilities are good. East-west and north-south U.S. Highways and railroads intersect at Lamar. Lamar also has a municipal airport with 2,500- and 2,900-foot runways. Railroads and main and secondary roads are well distributed in all areas. Communications in general are good in Barton County.

Grain markets are available in Lamar, Liberal, and Golden City. Livestock markets in Joplin, Springfield,

and Nevada, Missouri, are available by railroads and good roads. Good livestock markets are also at nearby Ft. Scott and Pittsburg, Kansas. The nearest large central markets are in Kansas City, St. Joseph, and St. Louis.

Agriculture and agribusiness are the most important enterprises in the county. Most of the people follow agricultural pursuits or work at retail sales or services. Major employers are engineering service companies, manufacturers of television and radio advertising equipment and parts, and manufacturers of novelties.

Banks and other financial institutions are in Lamar, Liberal, Golden City, and Mindenmines.

Cultural and Recreational Facilities

The schools of Barton County are consolidated into three districts. Adequate educational facilities, grades kindergarten through twelve, are located at Lamar, Liberal, and Golden City. Religious, medical, hospital, and nursing home facilities are also available.

Barton County is situated at the gateway of the vast prairies to the west and the beautiful Ozark Mountains to the east and south. Many of the famous vacation spots in the nation are not more than 100 miles away. These include Table Rock, Bull Shoals, Taney Como, Pomme de Terre, Stockton, and Grand Lakes. The Harry S. Truman dam across the Osage River at Kaysinger Bluff, soon to be completed, will create another large lake. This lake and Stockton Lake are conveniently nearby.

Farm ponds, mine pits, the 250-acre Lamar Lake, and other large impoundments make good fishing for bass and crappie. Each year hunters take large numbers of quail, rabbits, squirrels, doves, deer, ducks, and geese on farms and in mine-dump areas. A good swimming pool, lighted tennis courts and ball diamonds, shelter houses, and many other facilities are available at the Lamar City Park. The Lamar Golf and Country Club, now open to the public, will soon complete the construction of a new 9-hole golf course and a modern country club.

The birthplace of former President Harry S. Truman in Lamar is a tourist attraction. The Farm and Industrial Exposition held at Lamar every year is the largest free fair in Missouri. It was rated fourth place of 168 fairs in the State in 1967.

Climate [5]

Barton County has a typical continental climate that is characterized by frequent and often extreme changes in temperature, humidity, cloudiness, and winds, both from day to day and from year to year. For example, in July 1950 the maximum temperature never reached 90° F., but in July 1954 the maximum temperature averaged 101° and reached a high of 116° on the 15th.

The temperature has exceeded 100° in about 6 years out of 10. Generally, when the temperature reaches 100°, it will climb near or above that value for 3 or 4 days in a row. In July 1954, the temperature rose to 100° for 11 consecutive days, except for 1 day in the middle of this period when it reached 99°. In almost 2 out of every 3 winters, the temperature drops below zero. In 6 out of the past 30 years, there were times when the temperature dropped below zero on at least 7 consecutive days. The coldest temperature for the 30-year period was −18° on January 8, 1943.

The temperature and precipitation data given in table 10 are from the cooperative station of the National

[5] By WARREN M. WISNER, climatologist for Missouri, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation data*

[Data recorded at Lamar, Mo.]

Month	Temperature					Precipitation					
	Average daily			Two years in 10 will have at least 4 days with—		Monthly average	One year in 10 will have—		Greatest daily rainfall	Snowfall	
	Maximum	Minimum	Mean	Maximum temperature equal to or higher than	Minimum temperature equal to or lower than		Less than—	More than—		Monthly average	Greatest monthly average
	°F.	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Inches	Inches
January	42.5	20.5	31.5	63	1	1.47	0.41	2.81	1.43	2.6	13.0
February	47.0	24.3	35.6	65	10	1.87	.40	3.93	2.00	2.6	10.5
March	54.4	31.4	42.9	76	13	2.83	.98	4.60	2.23	3.1	22.0
April	67.9	44.5	56.2	82	30	4.21	1.47	7.53	3.00	[1]	1.1
May	75.7	54.2	65.0	87	41	5.18	2.58	10.27	3.90	0	0
June	83.5	63.3	73.4	94	52	5.50	1.35	10.10	5.60	0	0
July	88.9	66.9	77.9	99	58	3.65	.71	9.85	3.65	0	0
August	88.5	65.1	76.8	99	55	3.55	.99	6.52	4.15	0	0
September	80.7	56.7	68.7	93	43	4.58	1.30	8.96	4.62	0	0
October	71.2	46.0	58.6	86	30	3.47	.20	8.10	4.00	0	0
November	56.5	32.9	44.7	75	19	2.29	.20	4.48	4.95	.7	16.0
December	45.8	24.6	35.2	65	8	1.87	.33	3.56	2.75	2.2	10.5
Year	67.0	44.3	55.6			40.47	24.58	56.08	5.60	11.2	22.0

[1] Less than 0.05.

Weather Service at Lamar, Missouri, for the period 1941 through 1970. These data are representative of the climate in Barton County.

The average growing season is about 194 days. Some plants can tolerate lower temperatures than others; therefore, the growing season differs for different kinds of plants. Also, during periods of light wind, nighttime temperature in valleys is generally lower than it is on level ground or along ridges, and radiation freezes often occur. Table 11 shows the last date in spring and the first date in the fall when specified temperatures may be expected. The data in table 11 are based on instrument readings taken 5 feet above ground level. Frost may occur at ground level when the temperature at the observation level is above freezing.

Precipitation averages slightly more than 40 inches per year. Much of this falls during thunderstorms that result when the warm humid air from the Gulf of Mexico pushes northward late in spring. A secondary maximum occurs in fall. From late in June until the end of August, rainfall is uncertain because southwesterly winds from the Texas Panhandle can cause prolonged periods of hot, dry weather. Monthly extremes range from no precipitation in July 1970 to 15.55 inches in May 1961.

Snowfall averages about 11 inches a year, and the greatest amount generally falls in March.

Violent storms may occur when the hot, humid air from the Gulf of Mexico interacts with cool air from the north. Since 1916, there have been 15 tornadoes in Barton County, mostly in spring. Hail and damaging winds occur almost every year in some part of the county. Fortunately, the greatest likelihood of hail is in spring when it is the least damaging to growing field crops.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Chert. A very dense, cryptocrystalline, flintlike form of silica that breaks with a splintery fracture. It resists decomposition and generally remains as inert angular fragments in the residual mass. Chert fragments are up to 3 inches in diameter.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some con-

TABLE 11.—*Probability of last freezing temperatures in spring and first in fall*

[Data recorded at Lamar, Mo.]

Probability	Dates for given probability and temperature				
	32°F. or lower	28°F. or lower	24°F. or lower	20°F. or lower	16°F. or lower
Spring:					
1 year in 10 later than	May 1	April 18	April 8	March 31	March 22.
2 years in 10 later than	April 26	April 13	April 2	March 25	March 16.
5 years in 10 later than	April 17	April 5	March 23	March 14	March 2.
Fall:					
1 year in 10 earlier than	October 1	October 13	October 26	October 30	November 10.
2 years in 10 earlier than	October 13	October 21	October 29	November 8	November 16.
5 years in 10 earlier than	October 25	October 30	November 10	November 18	December 1.

cretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Depth, soil. Three classes of soil depth are used in this soil survey. They are *deep*, more than 40 inches; *moderately deep*, 20 to 40 inches; and *shallow*, 0 to 20 inches.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is know to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is commonly the material in which a soil has formed.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. The leached layer beneath the surface layer.

Subsurface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Technically, the A1 horizon.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," fine," or "very fine."

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which it belongs. For general information about the use of the soils as woodland and as wildlife habitat, refer to the sections "Use of the Soils for Woodland" and "Use of the Soils for Wildlife." Other information is given in tables as follows:

Acreage and extent, table 1, p. 9.
Predicted yields, table 2, p. 43.
Woodland suitability groups of soils, table 3, p. 44
Potential of the soils for wildlife, table 4, p. 48.
Limitations of soils for recreational sites, table 5, p. 52.
Engineering uses of the soils, tables 6, 7, and 8, pp. 54 through 65.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group
			Symbol	Page	Number
AkB	Askew fine sandy loam, 2 to 5 percent slopes	10	IIIe-4	39	1o7
AsB	Askew silt loam, 2 to 5 percent slopes	10	IIe-1	38	1o7
AsB2	Askew silt loam, 2 to 5 percent slopes, eroded	10	IIIe-4	39	1o7
BaB	Barco fine sandy loam, 2 to 5 percent slopes	12	IIIe-4	39	---
BaB2	Barco fine sandy loam, 2 to 5 percent slopes, eroded	12	IVe-7	40	---
BcB	Barco loam, 2 to 5 percent slopes	12	IIe-4	38	---
BcB2	Barco loam, 2 to 5 percent slopes, eroded	12	IIIe-4	39	---
BdB	Barden silt loam, 1 to 4 percent slopes	13	IIe-2	38	---
BdB2	Barden silt loam, 1 to 4 percent slopes, eroded	14	IIIe-5	39	---
BoB	Bolivar fine sandy loam, 2 to 5 percent slopes	15	IIIe-4	39	4o7
BoB2	Bolivar fine sandy loam, 2 to 5 percent slopes, eroded	15	IVe-7	40	4o7
Br	Breaks-Alluvial land complex	15	VIe-7	41	---
BsB	Bronaugh silt loam, 2 to 5 percent slopes	16	IIe-1	38	---
Ca	Carytown silt loam	17	IIIw-12	40	---
Ce	Cherokee silt loam	18	IIw-1	39	---
Cf	Cleora fine sandy loam	19	IIIw-2	40	4w5
CoB	Collinsville fine sandy loam, 2 to 5 percent slopes	20	IVs-8	40	---
CoD	Collinsville fine sandy loam, 5 to 14 percent slopes	20	VIs-8	41	---
CrD	Collinsville stony fine sandy loam, 2 to 14 percent slopes	20	VIIs-10	42	---
CsB	Creldon silt loam, 1 to 4 percent slopes	21	IIIe-5	39	---
CsB2	Creldon silt loam, 1 to 4 percent slopes, eroded	22	IVe-7	40	---
CtB	Creldon silt loam, deep, 1 to 4 percent slopes	22	IIe-2	38	---
HcB	Hector fine sandy loam, 2 to 5 percent slopes	23	IVs-8	40	5d9
HcD	Hector fine sandy loam, 5 to 14 percent slopes	23	VIs-8	41	5d9
HeD	Hector stony fine sandy loam, 2 to 14 percent slopes	23	VIIs-10	42	5d9
HeE	Hector stony fine sandy loam, 14 to 30 percent slopes	23	VIIs-10	42	5d9
Hm	Hepler silt loam	24	IIIw-1	40	4w3
Hp	Hepler silt loam, overwash	24	IIw-1	39	4w3
Hr	Hepler-Radley silt loams	25	IIIw-1	40	4w3
KeC	Keeno cherty silt loam, 2 to 9 percent slopes	26	IVs-9	41	---
KnC	Keeno stony silt loam, 2 to 9 percent slopes	26	VIIs-10	42	---
La	Lanton silty clay loam	27	IIw-1	39	4w3
Ld	Lanton and Verdigris silt loams	27	IIw-1	39	4w3
LeB	Lebanon silt loam, 2 to 5 percent slopes	28	IIIe-5	39	4o7
LlB	Liberal silt loam, 2 to 6 percent slopes	29	IIIe-5	39	---
LmC2	Liberal silty clay loam, 2 to 9 percent slopes, eroded	29	IVe-7	40	---
LoD	Liberal, Collinsville and Barco soils, 2 to 14 percent slopes	30	VIe-7	41	---
Mp	Mine pits and dumps	30	VIIe-7	42	4t9
NeB	Newtonia silt loam, 1 to 3 percent slopes	31	IIe-1	38	---
NhC	Nixa cherty silt loam, 2 to 9 percent slopes	32	VIs-9	41	4f8
PaA	Parsons silt loam, 0 to 1 percent slopes	33	IIs-2	39	---
PaB	Parsons silt loam, 1 to 3 percent slopes	33	IIIe-2	39	---
PaB2	Parsons silt loam, 1 to 3 percent slopes, eroded	34	IIIe-5	39	---
Rv	Radley and Verdigris silt loams	34	IIIw-1	40	3w5
SuA	Summit silty clay loam, 0 to 2 percent slopes	35	IIw-1	39	---
SuB	Summit silty clay loam, 2 to 5 percent slopes	35	IIe-2	38	---

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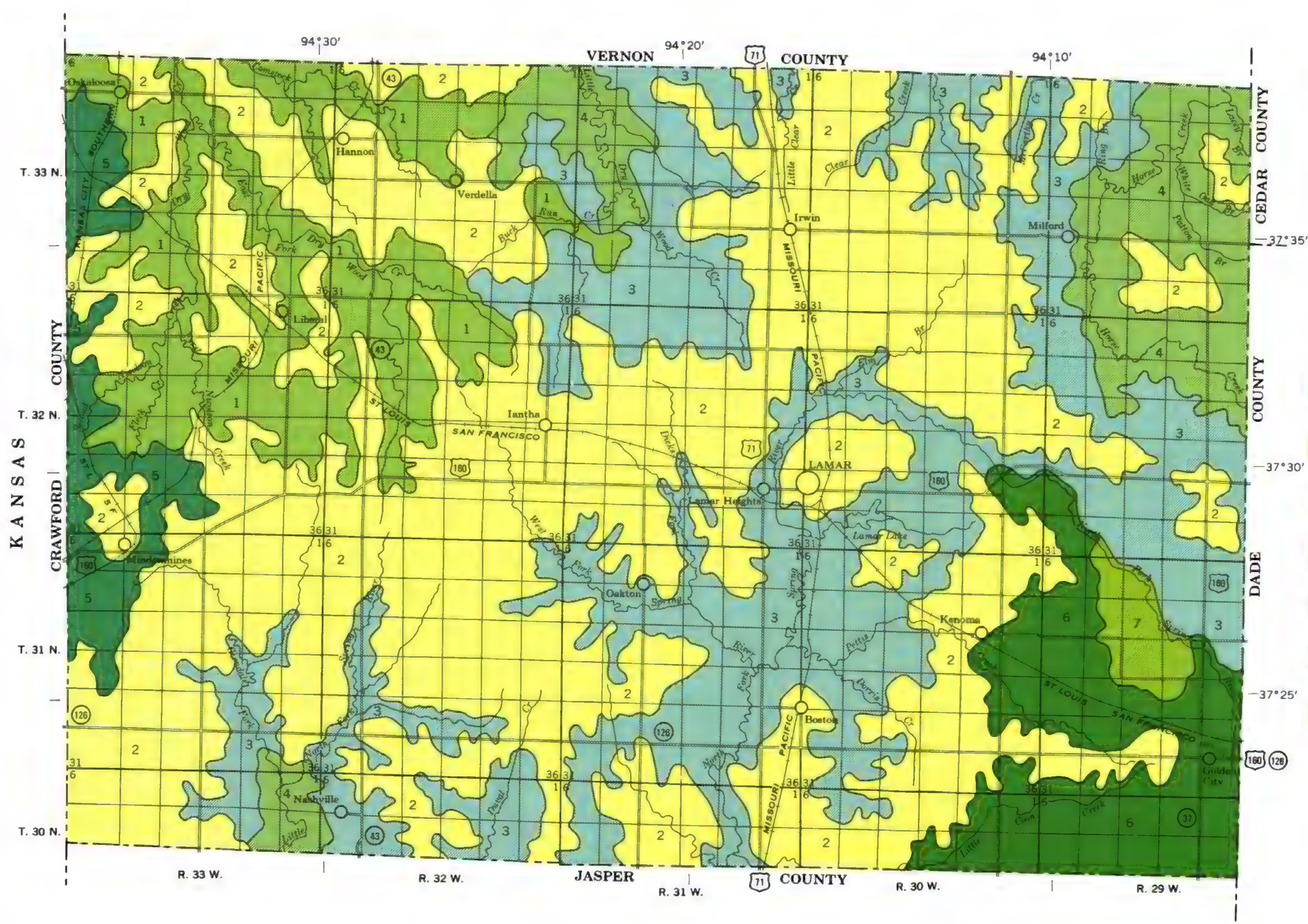
All Other Inquires

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).



SOIL ASSOCIATIONS

1. Liberal-Collinsville-Barco association: Shallow to moderately deep, moderately well drained to well drained, gently sloping to moderately steep soils of the uplands; formed under grass in sandstone and shale residuum
2. Parsons-Barden association: Deep, somewhat poorly drained and moderately well drained, nearly level and gently sloping soils of the uplands; formed under grass in shale residuum
3. Barco-Collinsville association: Shallow to moderately deep, well-drained, gently sloping to moderately steep soils of the uplands; formed under grass in sandstone residuum
4. Hector-Bolivar association: Shallow to moderately deep, well-drained, gently sloping to steep soils of the uplands; formed under trees in sandstone residuum
5. Mine pits and dumps association: Large trenchlike pits and irregularly shaped dumps consisting of a mixture of shale, sandstone, and soil stripped from coalbeds
6. Creldon-Carytown-Parsons association: Deep, poorly drained to moderately well drained, nearly level to sloping soils of the uplands; formed under grass in cherty limestone and shale residuum
7. Nixa-Lebanon association: Deep, moderately well drained, gently sloping and sloping soils of the uplands; formed under trees in cherty limestone residuum

Compiled 1972

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MISSOURI AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
BARTON COUNTY, MISSOURI

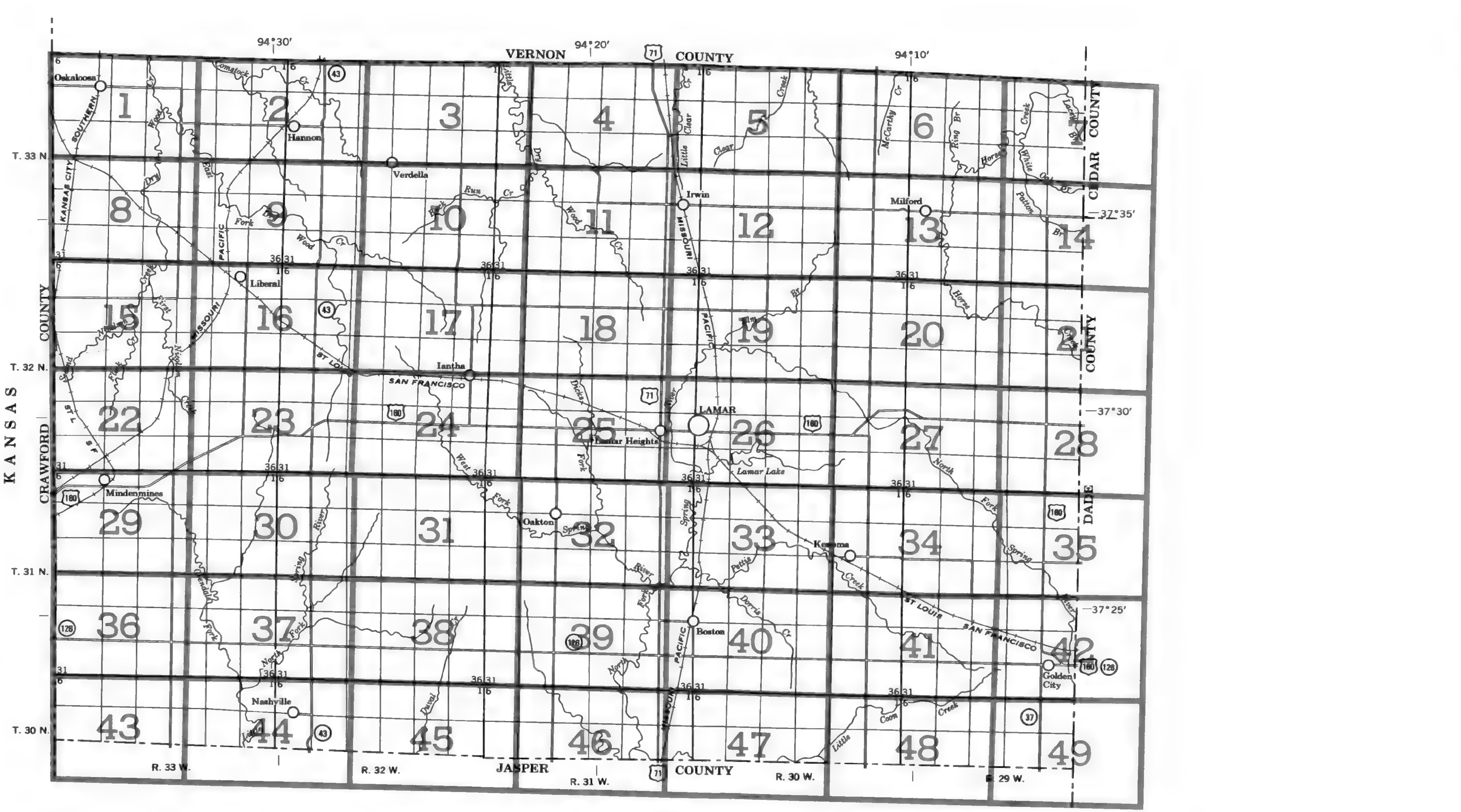
Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

BARTON COUNTY, MISSOURI

Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range of slope. A final number, 2, in a symbol shows that the soil is eroded.

SYMBOL	NAME
AkB	Askew fine sandy loam, 2 to 5 percent slopes
AsB	Askew silt loam, 2 to 5 percent slopes
AsB2	Askew silt loam, 2 to 5 percent slopes, eroded
BaB	Barco fine sandy loam, 2 to 5 percent slopes
BaB2	Barco fine sandy loam, 2 to 5 percent slopes, eroded
BcB	Barco loam, 2 to 5 percent slopes
BcB2	Barco loam, 2 to 5 percent slopes, eroded
BdB	Barden silt loam, 1 to 4 percent slopes
BdB2	Barden silt loam, 1 to 4 percent slopes, eroded
BoB	Bolivar fine sandy loam, 2 to 5 percent slopes
BoB2	Bolivar fine sandy loam, 2 to 5 percent slopes, eroded
Br	Breaks-Alluvial land complex
BsB	Bronaugh silt loam, 2 to 5 percent slopes
Ca	Carytown silt loam
Ce	Cherokee silt loam
Cf	Cleora fine sandy loam
CoB	Collinsville fine sandy loam, 2 to 5 percent slopes
CoD	Collinsville fine sandy loam, 5 to 14 percent slopes
CrD	Collinsville stony fine sandy loam, 2 to 14 percent slopes
CsB	Creldon silt loam, 1 to 4 percent slopes
CsB2	Creldon silt loam, 1 to 4 percent slopes, eroded
CtB	Creldon silt loam, deep, 1 to 4 percent slopes
HcB	Hector fine sandy loam, 2 to 5 percent slopes
HcD	Hector fine sandy loam, 5 to 14 percent slopes
HeD	Hector stony fine sandy loam, 2 to 14 percent slopes
HeE	Hector stony fine sandy loam, 14 to 30 percent slopes
Hm	Hepler silt loam
Hp	Hepler silt loam, overwash
Hr	Hepler-Radley silt loams
KeC	Keeno cherty silt loam, 2 to 9 percent slopes
KnC	Keeno stony silt loam, 2 to 9 percent slopes
La	Lanton silty clay loam
Ld	Lanton and Verdigris silt loams
Leb	Lebanon silt loam, 2 to 5 percent slopes
LlB	Liberal silt loam, 2 to 6 percent slopes
LmC2	Liberal silty clay loam, 2 to 9 percent slopes, eroded
LoD	Liberal, Collinsville and Barco soils, 2 to 14 percent slopes
Mp	Mine pits and dumps
NeB	Newtonia silt loam, 1 to 3 percent slopes
NhC	Nixa cherty silt loam, 2 to 9 percent slopes
PaA	Parsons silt loam, 0 to 1 percent slopes
PaB	Parsons silt loam, 1 to 3 percent slopes
PaB2	Parsons silt loam, 1 to 3 percent slopes, eroded
Rv	Radley and Verdigris silt loams
SuA	Summit silty clay loam, 0 to 2 percent slopes
SuB	Summit silty clay loam, 2 to 5 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

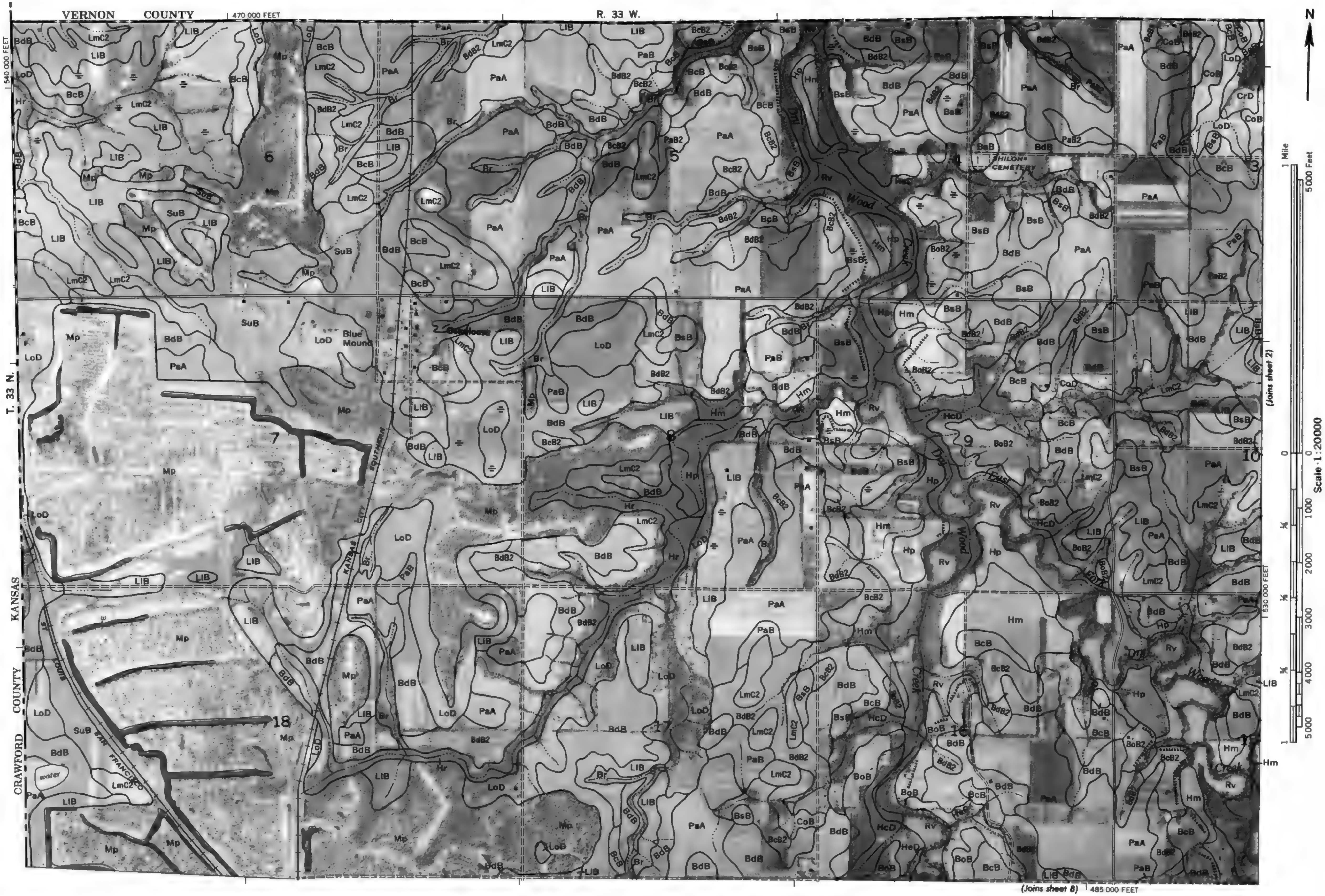
Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony; Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

BARTON COUNTY, MISSOURI — SHEET NUMBER 1



BARTON COUNTY, MISSOURI NO. 1

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone. Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 2

3

BARTON COUNTY, MISSOURI NO. 3

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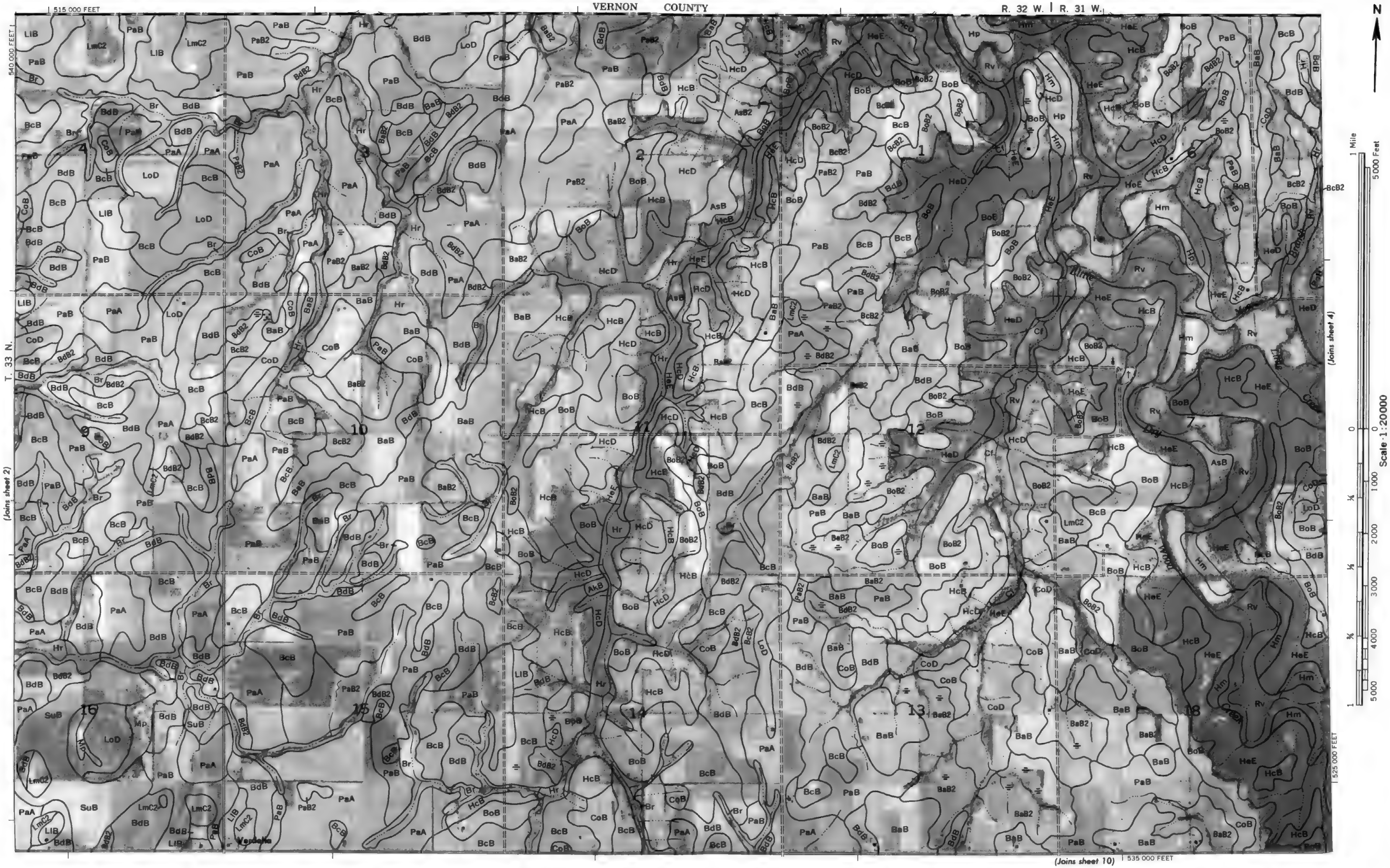
Land division corners are approximately positioned on this map.



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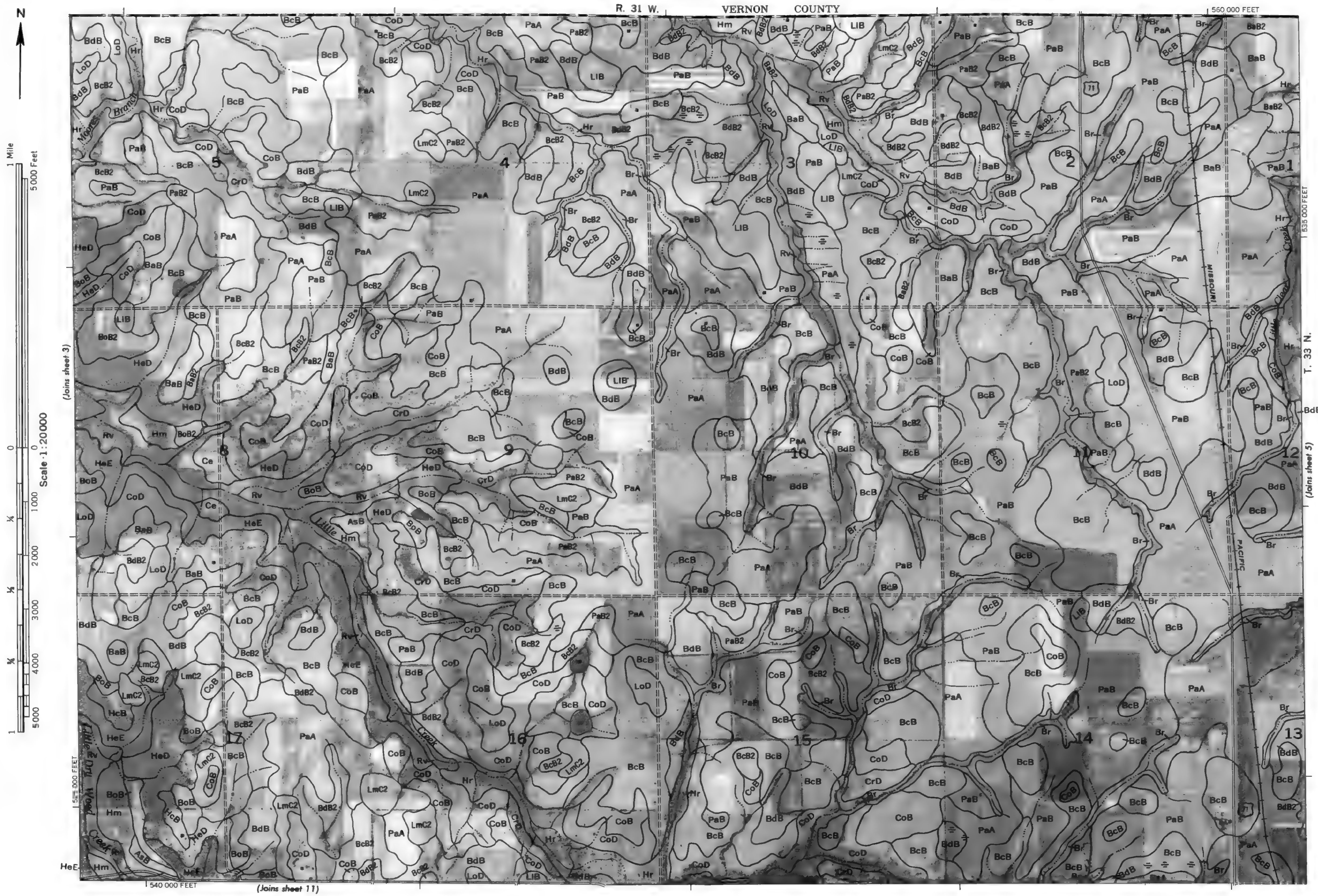
BARTON COUNTY, MISSOURI — SHEET NUMBER 4



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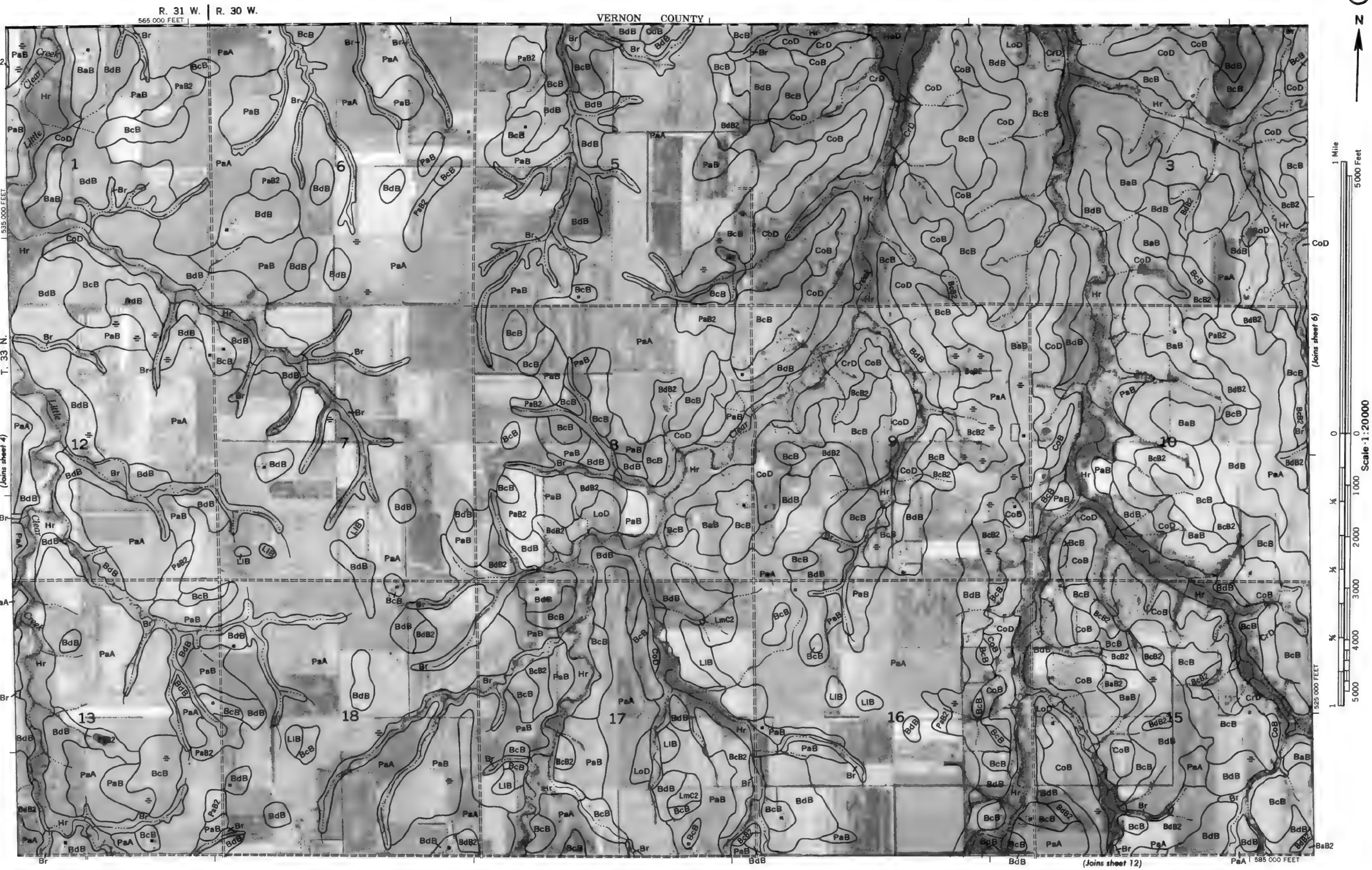
BARTON COUNTY, MISSOURI NO. 4

BARTON COUNTY, MISSOURI — SHEET NUMBER 5



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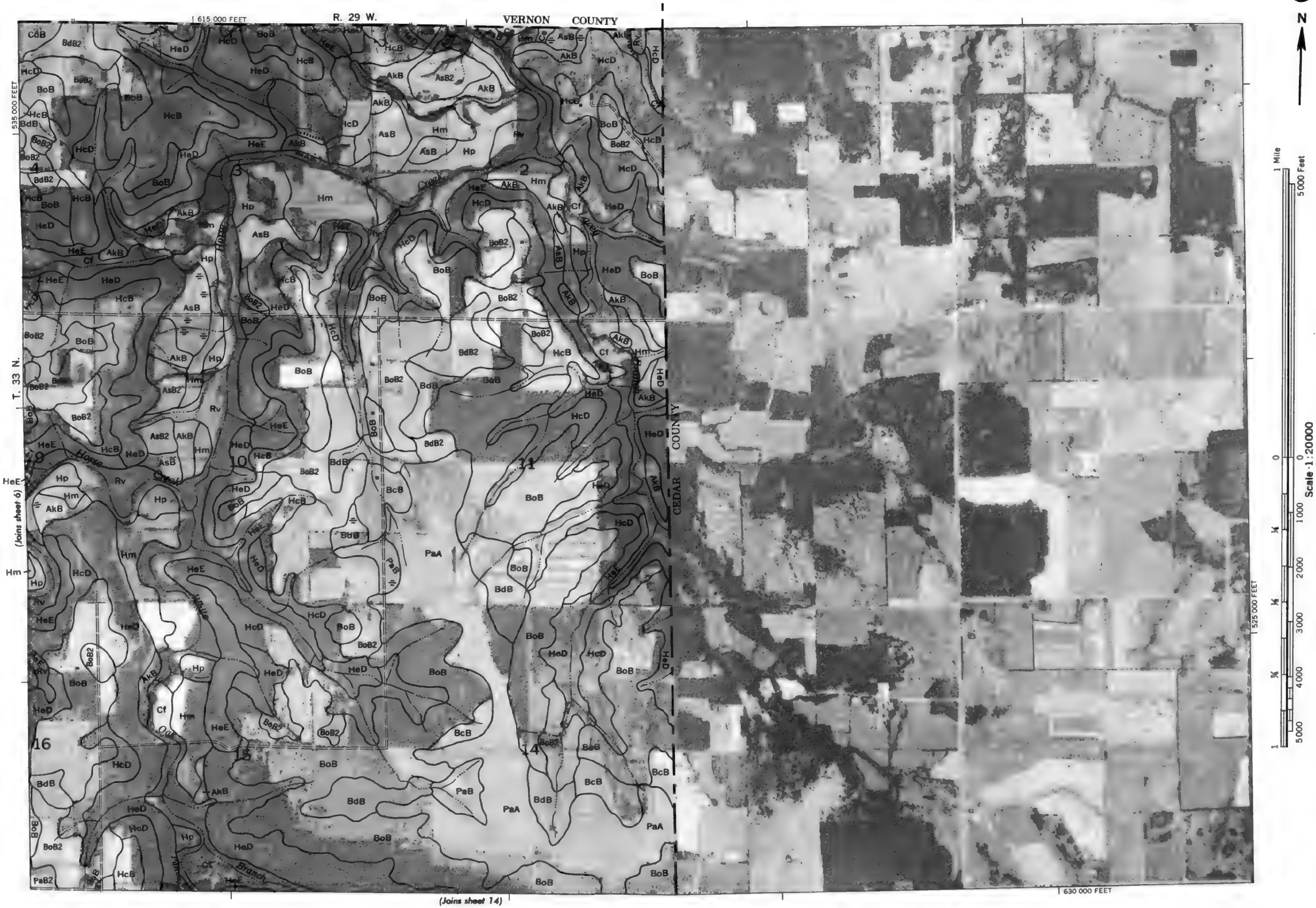
Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 6



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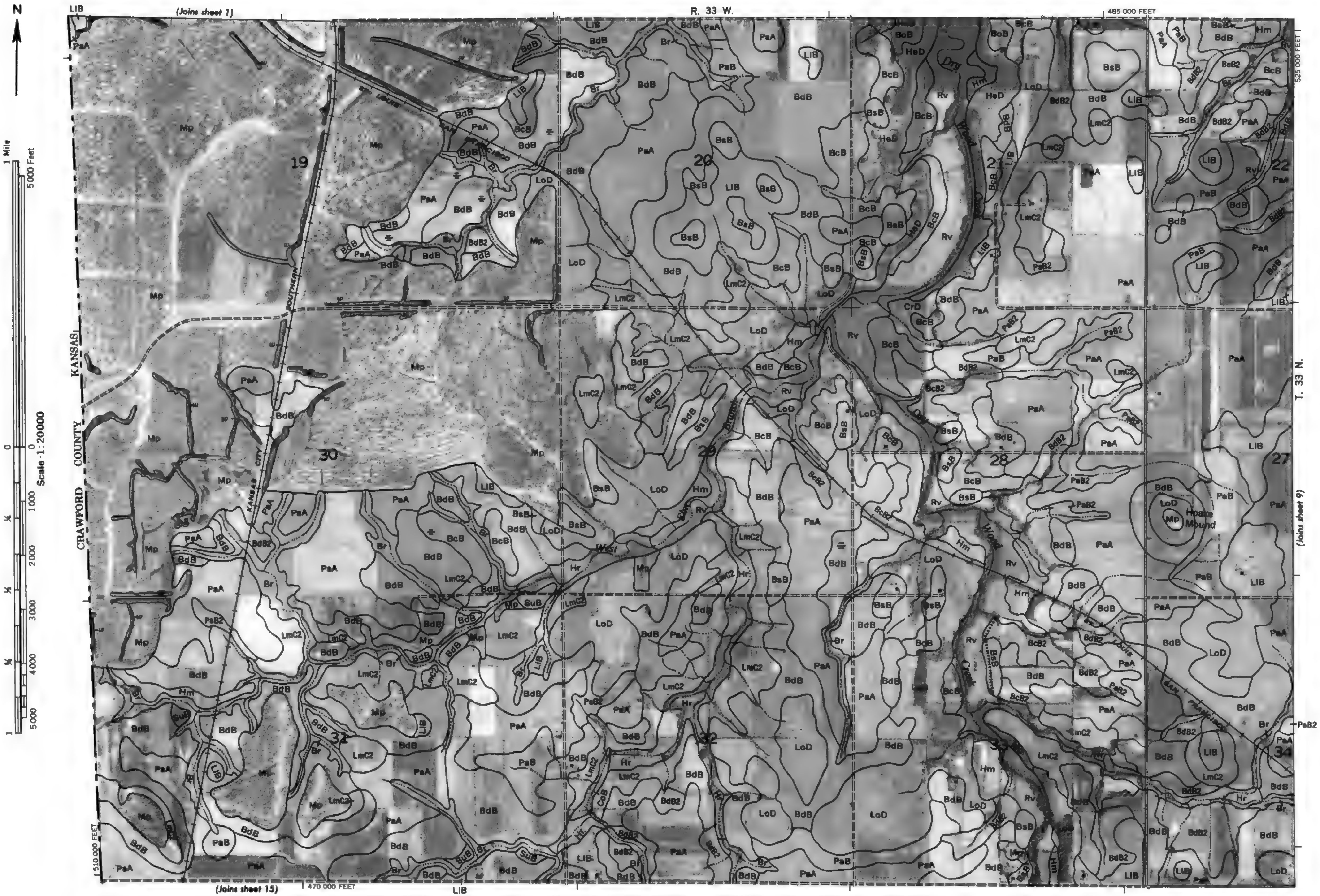
BARTON COUNTY, MISSOURI — SHEET NUMBER 8



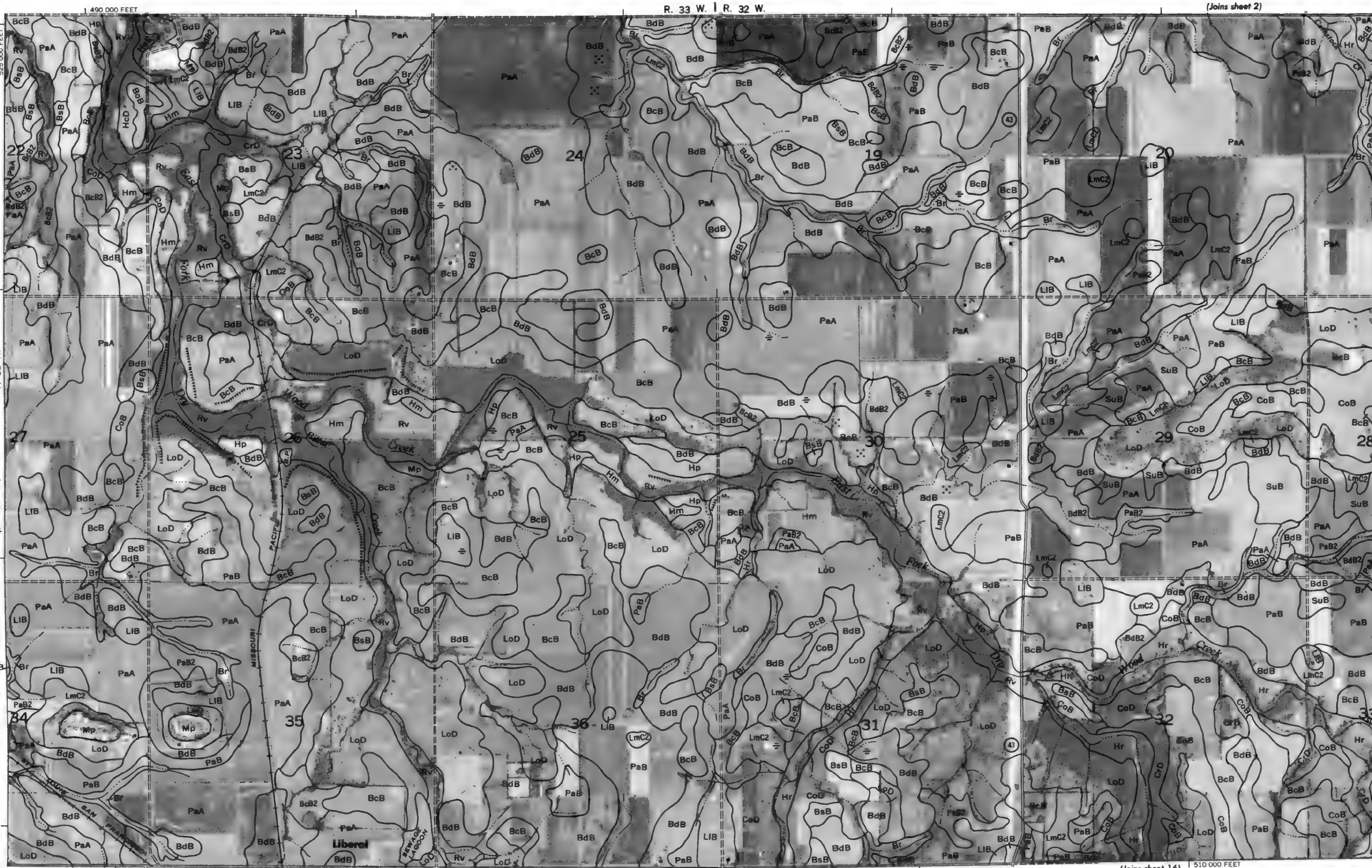
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

9

N



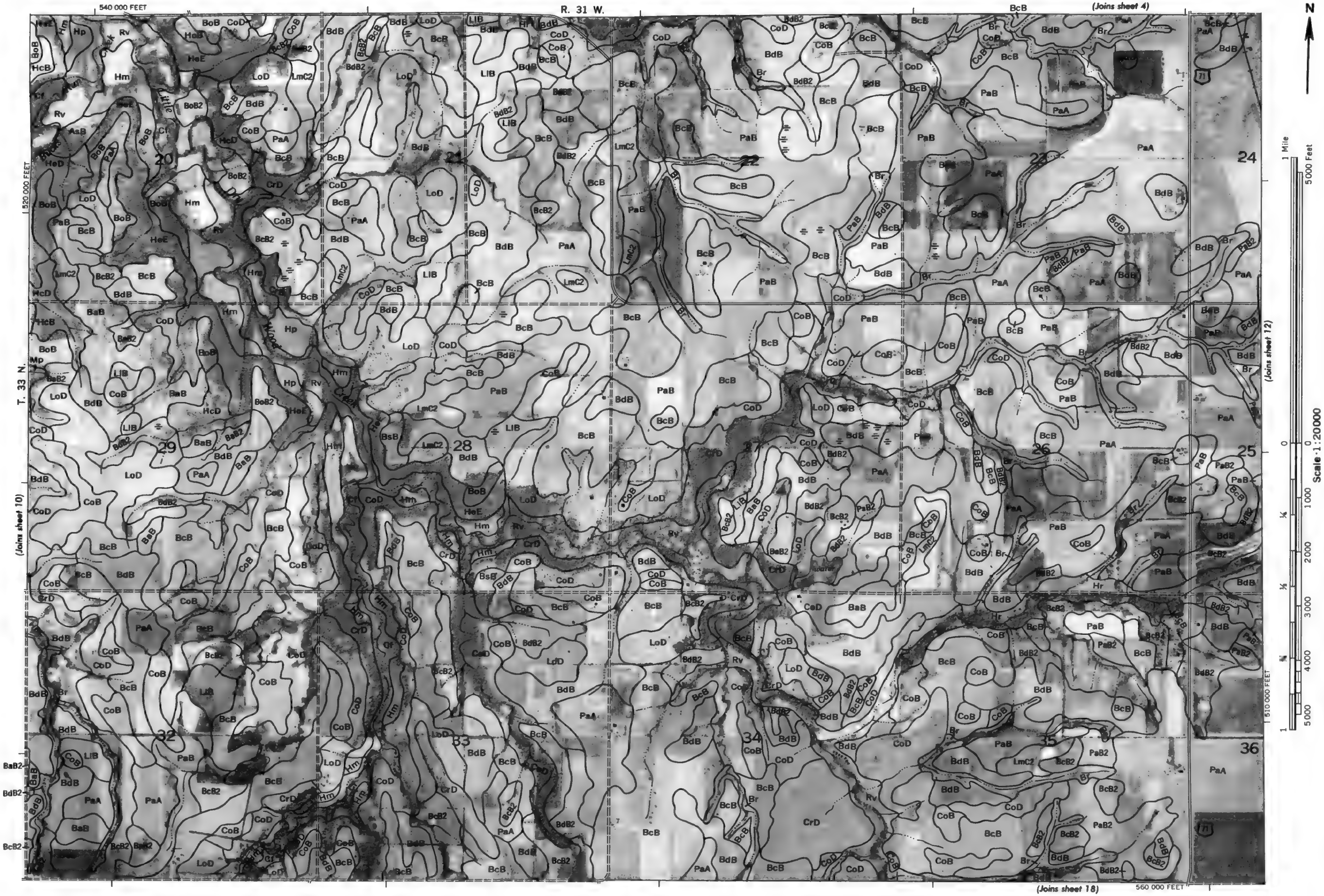
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000

BARTON COUNTY, MISSOURI NO. 9

BARTON COUNTY, MISSOURI — SHEET NUMBER 10

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.



BARTON COUNTY, MISSOURI NO. 11

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone. Land division corners are approximately positioned on this map.

(12)

BARTON COUNTY, MISSOURI — SHEET NUMBER 12

BARTON COUNTY, MISSOURI NO. 12


R. 30 W.
R. 29 W.
T. 33 N.
590 000 FEET
520 000 FEET
510 000 FEET
610 000 FEET
(Joins sheet 6)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 20)
Milford
Hyder Branch
Horse Creek
HOWELL CEMETERY
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
N
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
Scale 1:20000

BARTON COUNTY, MISSOURI — SHEET NUMBER 14

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

BARTON COUNTY, MISSOURI NO. 14

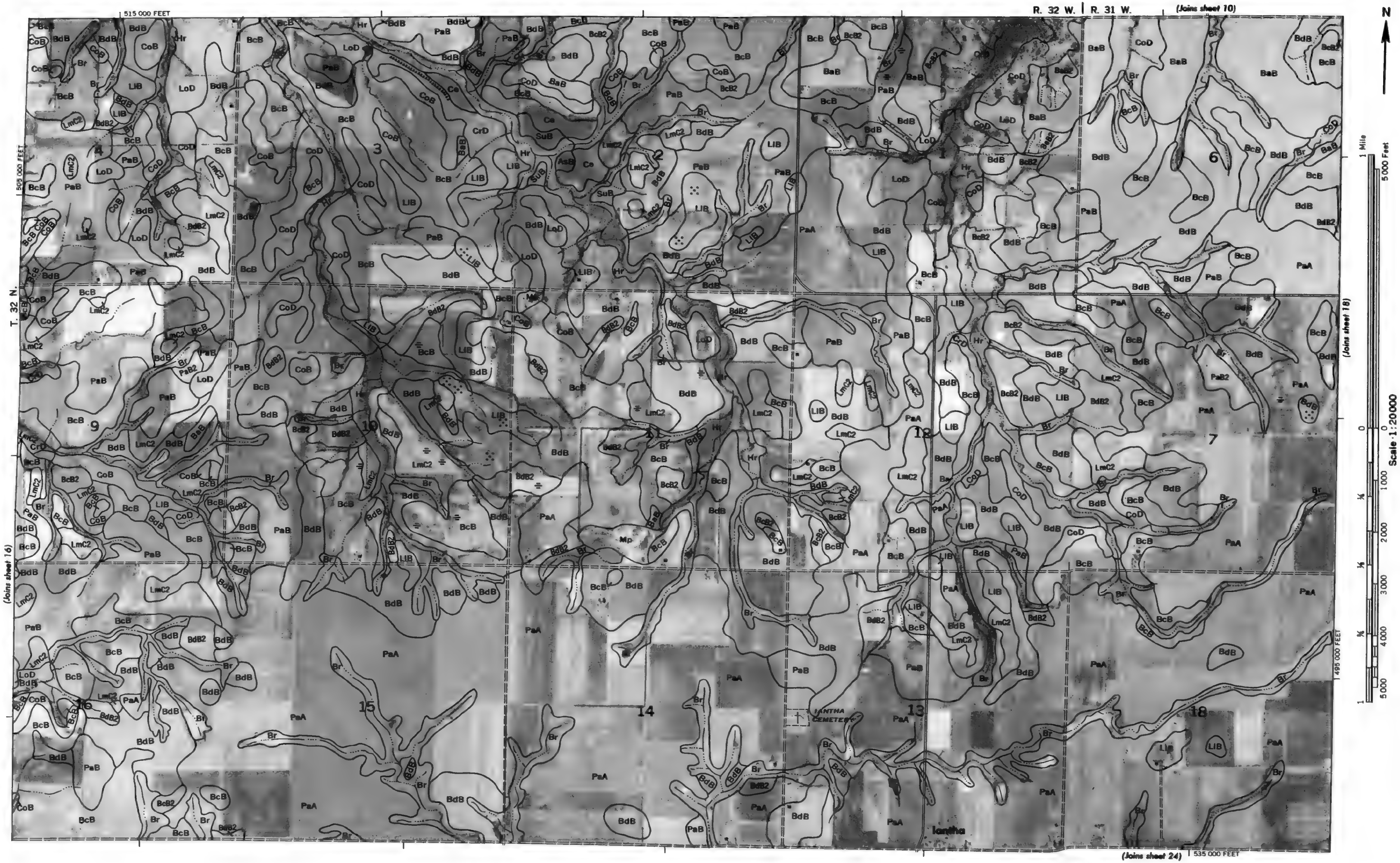
BARTON COUNTY, MISSOURI — SHEET NUMBER 15

BARTON COUNTY, MISSOURI NO. 15

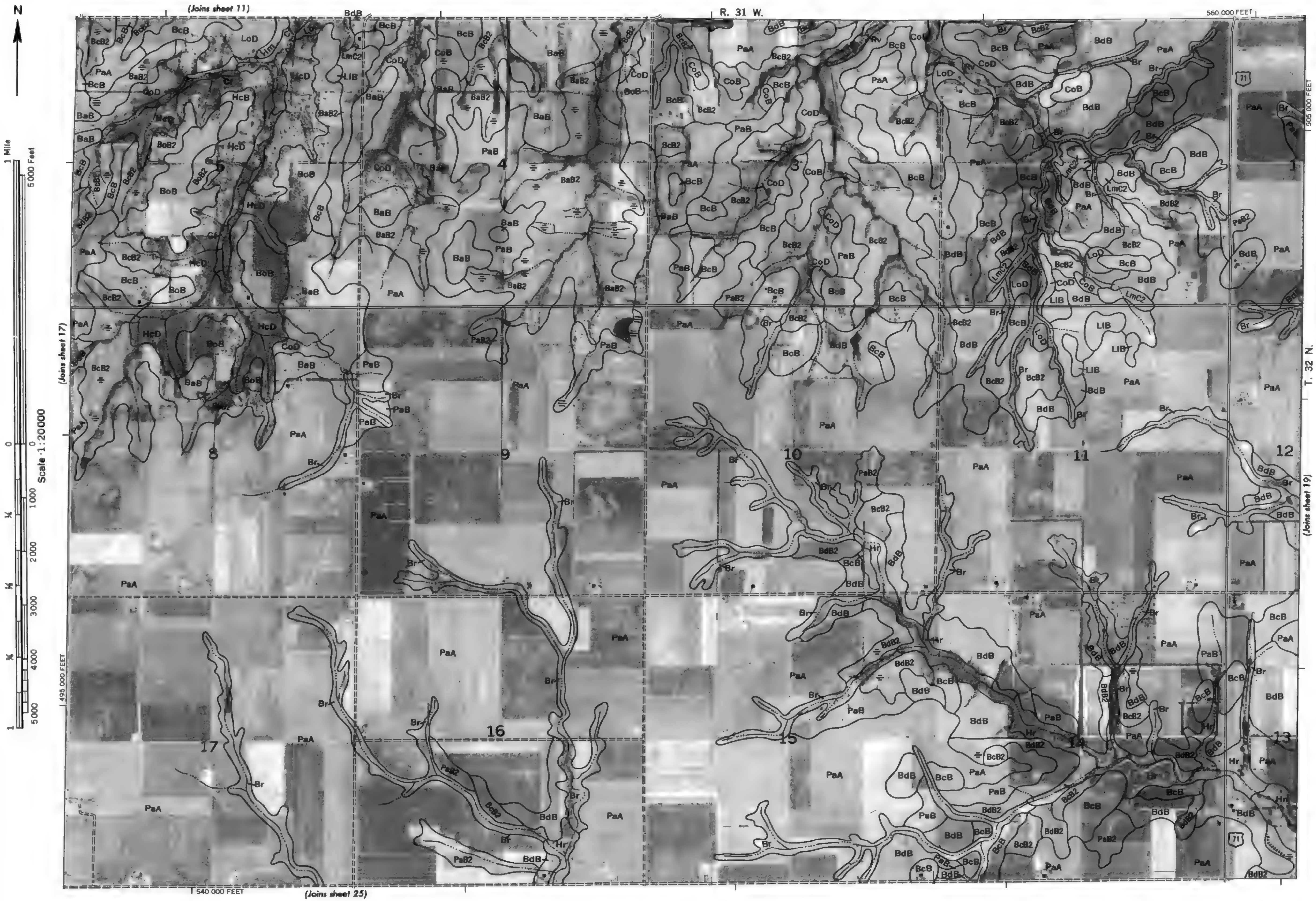
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 16

BARTON COUNTY, MISSOURI NO. 16


515 000 FEET
R. 32 W.
R. 31 W.
(Joins sheet 10)
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 18)
495 000 FEET
(Joins sheet 24)
535 000 FEET
(Joins sheet 16)
505 000 FEET
T. 32 N.
IANTHA CEMETERY
Iantha
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18

BARTON COUNTY, MISSOURI — SHEET NUMBER 18

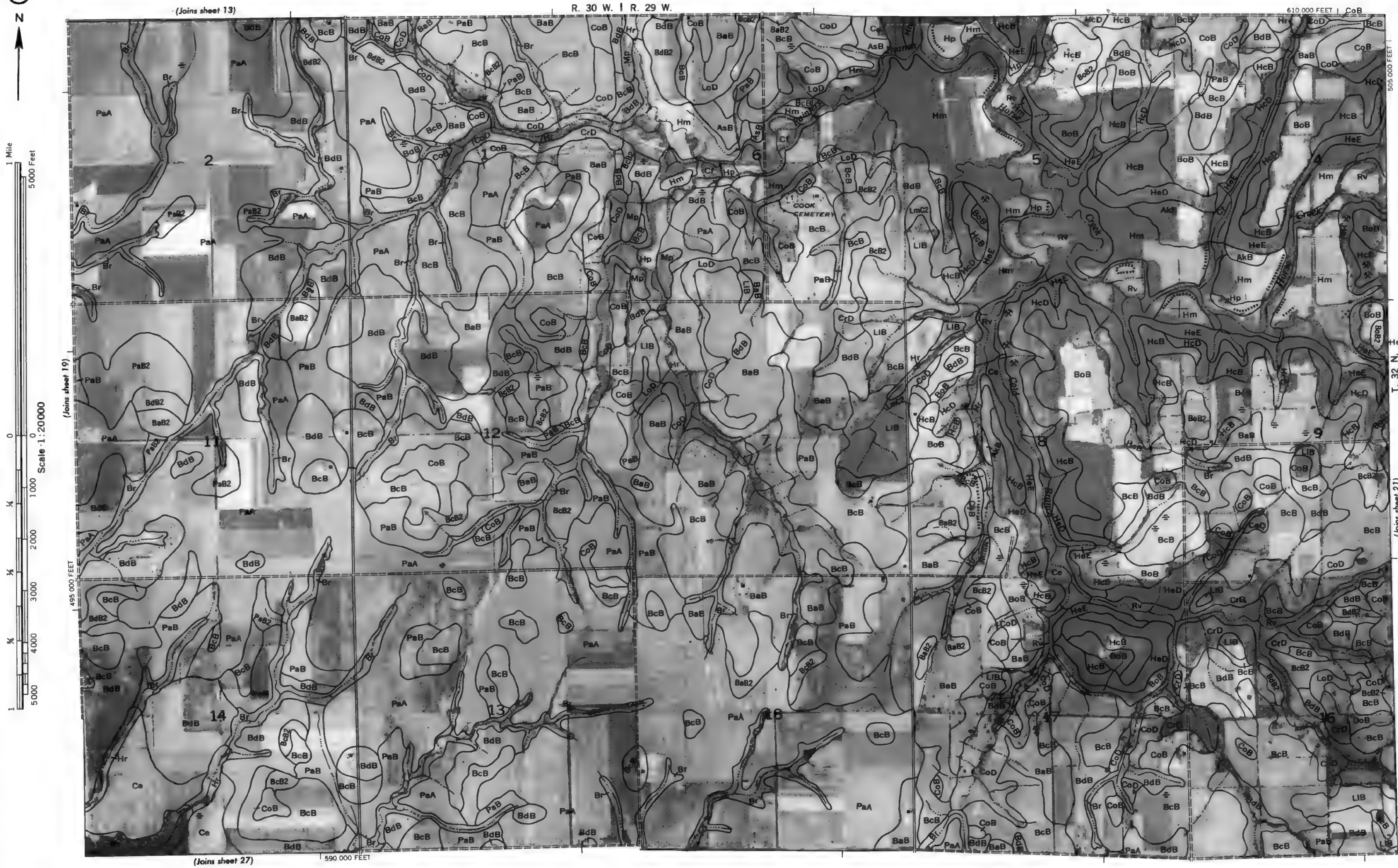


Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

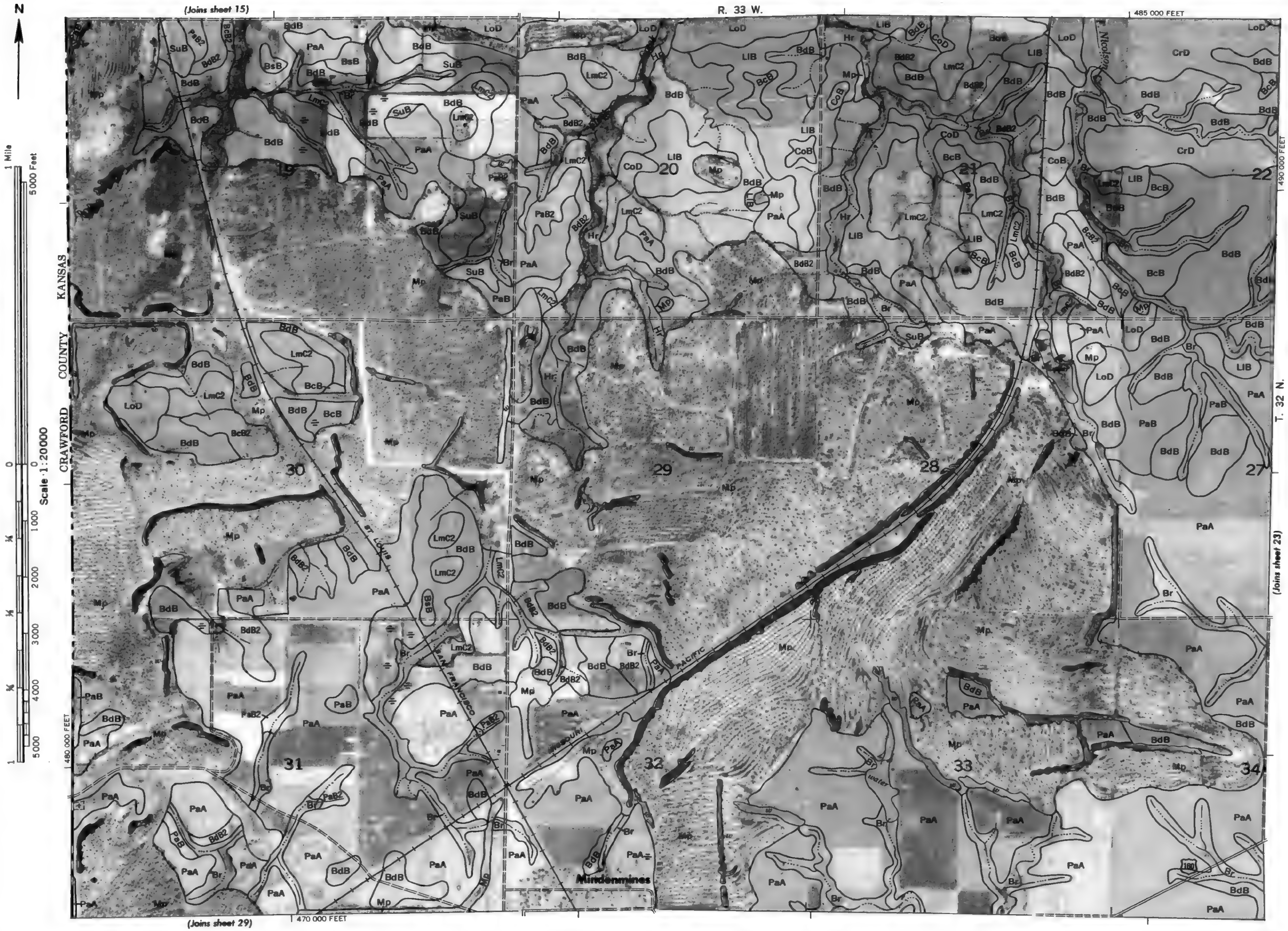
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.


R. 31 W.
R. 30 W.
565 000 FEET
(Joins sheet 12)
N
(Joins sheet 20)
(Joins sheet 18)
(Joins sheet 26)
585 000 FEET
505 000 FEET
495 000 FEET
T. 32 N.
1 Mile
5000 Feet
Scale 1:20000
HIGH CEMETERY
MISSOURI PACIFIC
NORTH FORK
Spring River
North Fork
SPRING RIVER
Branch
1
3
5
6
7
8
9
10
12
13
15
16
17
18


N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
(Joins sheet 13)
R. 30 W. | R. 29 W.
610 000 FEET
505 000 FEET
495 000 FEET
590 000 FEET
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 27)
T. 32 N.
COOK CEMETERY
Horse Creek
Cold Branch
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18

BARTON COUNTY, MISSOURI NO. 21

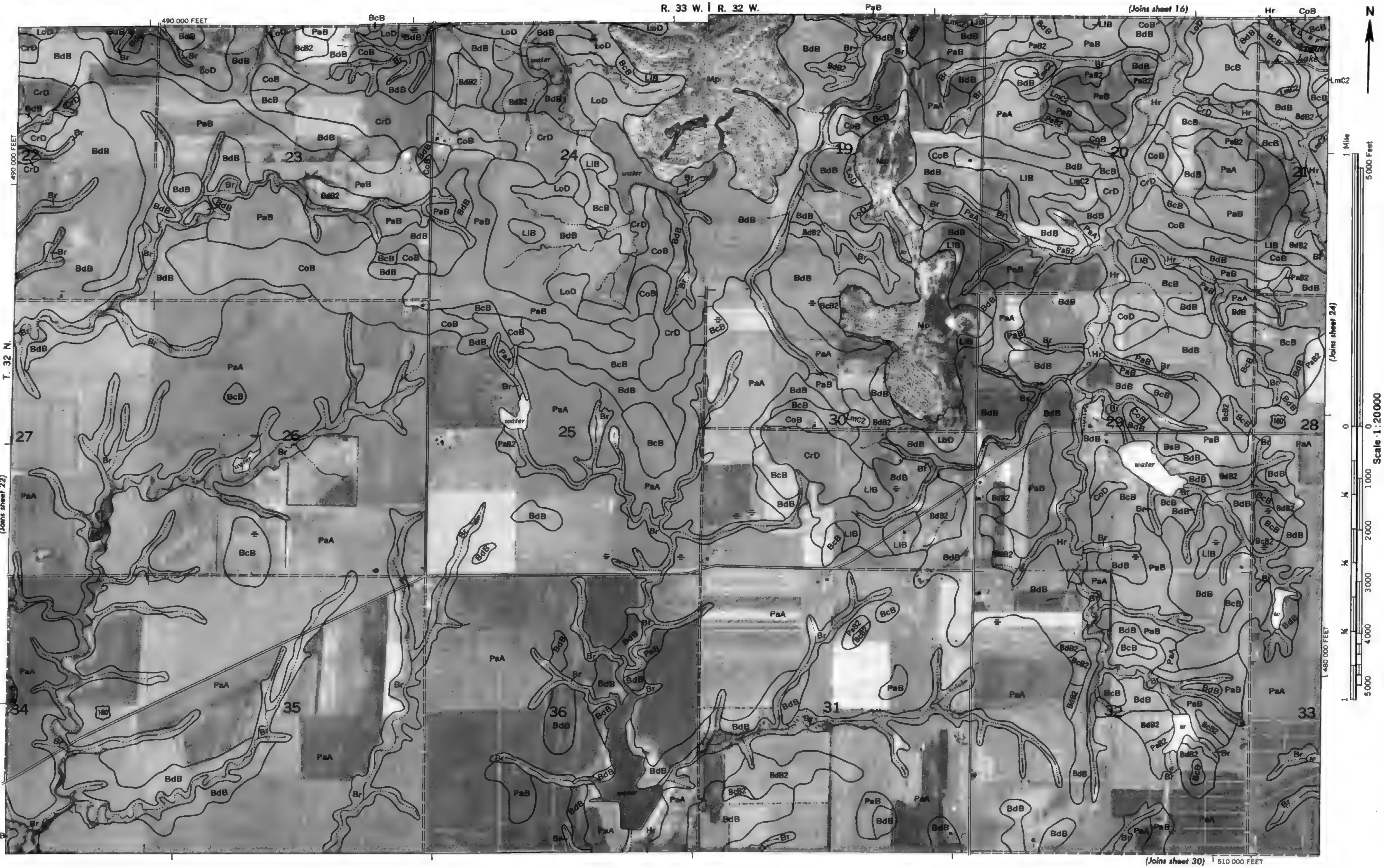
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

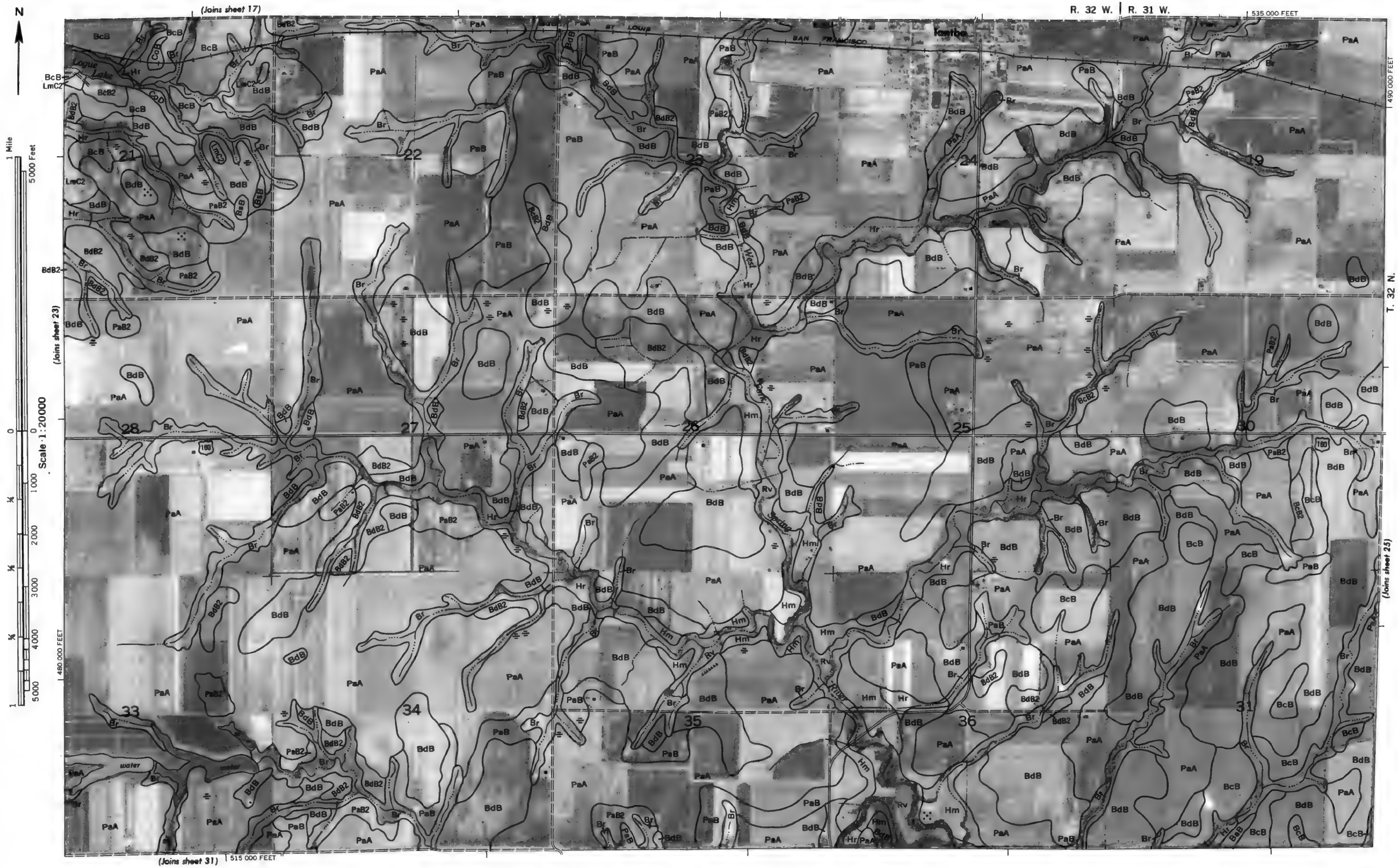
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.



BARTON COUNTY, MISSOURI NO. 23

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone. Land division corners are approximately positioned on this map.


N
(Joins sheet 17)
R. 32 W.
R. 31 W.
535 000 FEET
490 000 FEET
T. 32 N.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 31)
515 000 FEET
480 000 FEET
Logue Lake
Iantha
ST LOUIS SAN FRANCISCO
West Fork
Spring River
water
160
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1

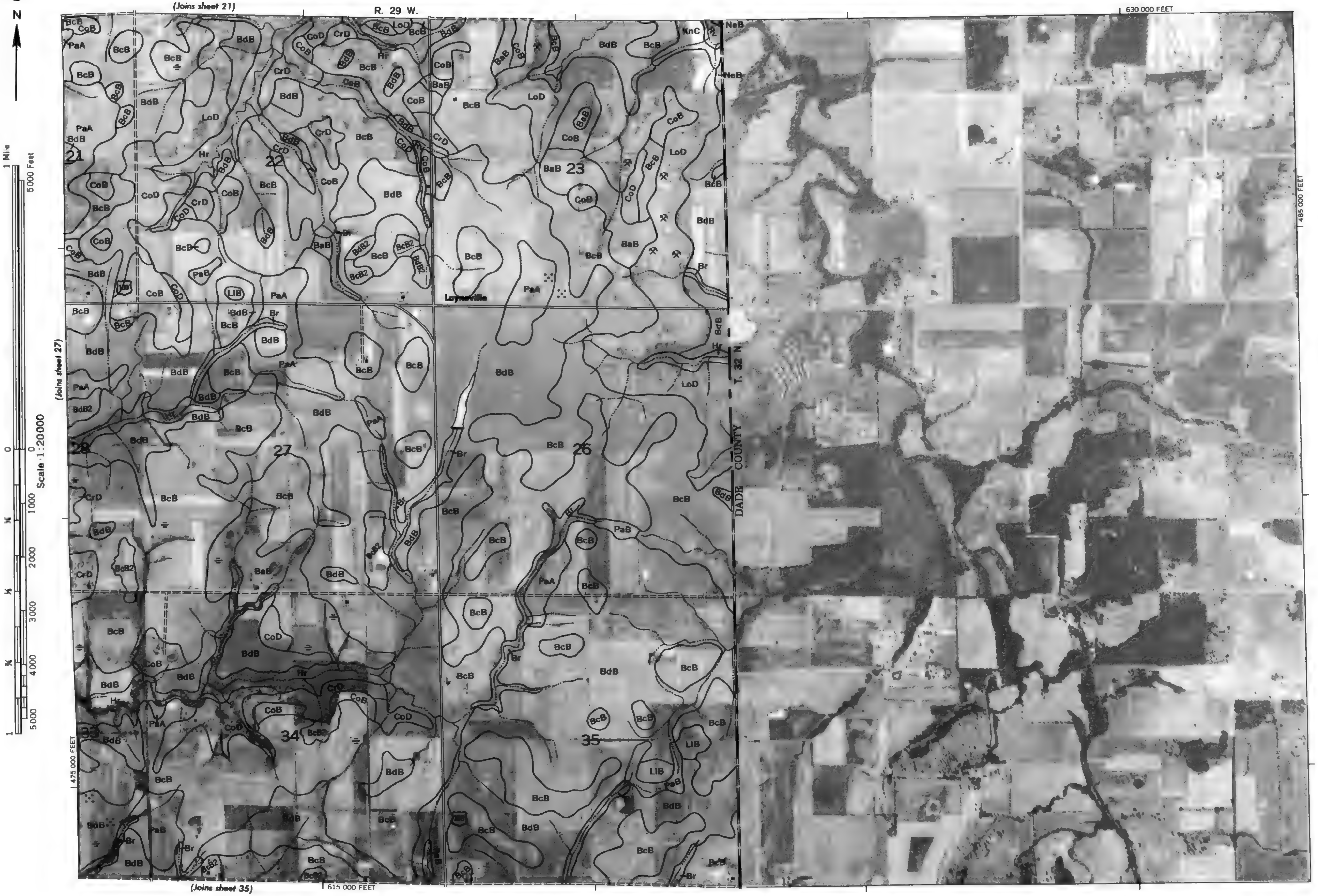
BARTON COUNTY, MISSOURI NO. 25

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone. Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 26


27
R. 30 W. | R. 29 W.
590 000 FEET
490 000 FEET
(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 34)
610 000 FEET
475 000 FEET
T. 32 N.
N
FAIRVIEW CEMETERY
North Fork Spring River
Scale 1:20000
1 Mile
5000 Feet
BARTON COUNTY, MISSOURI NO. 27

BARTON COUNTY, MISSOURI — SHEET NUMBER 28



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

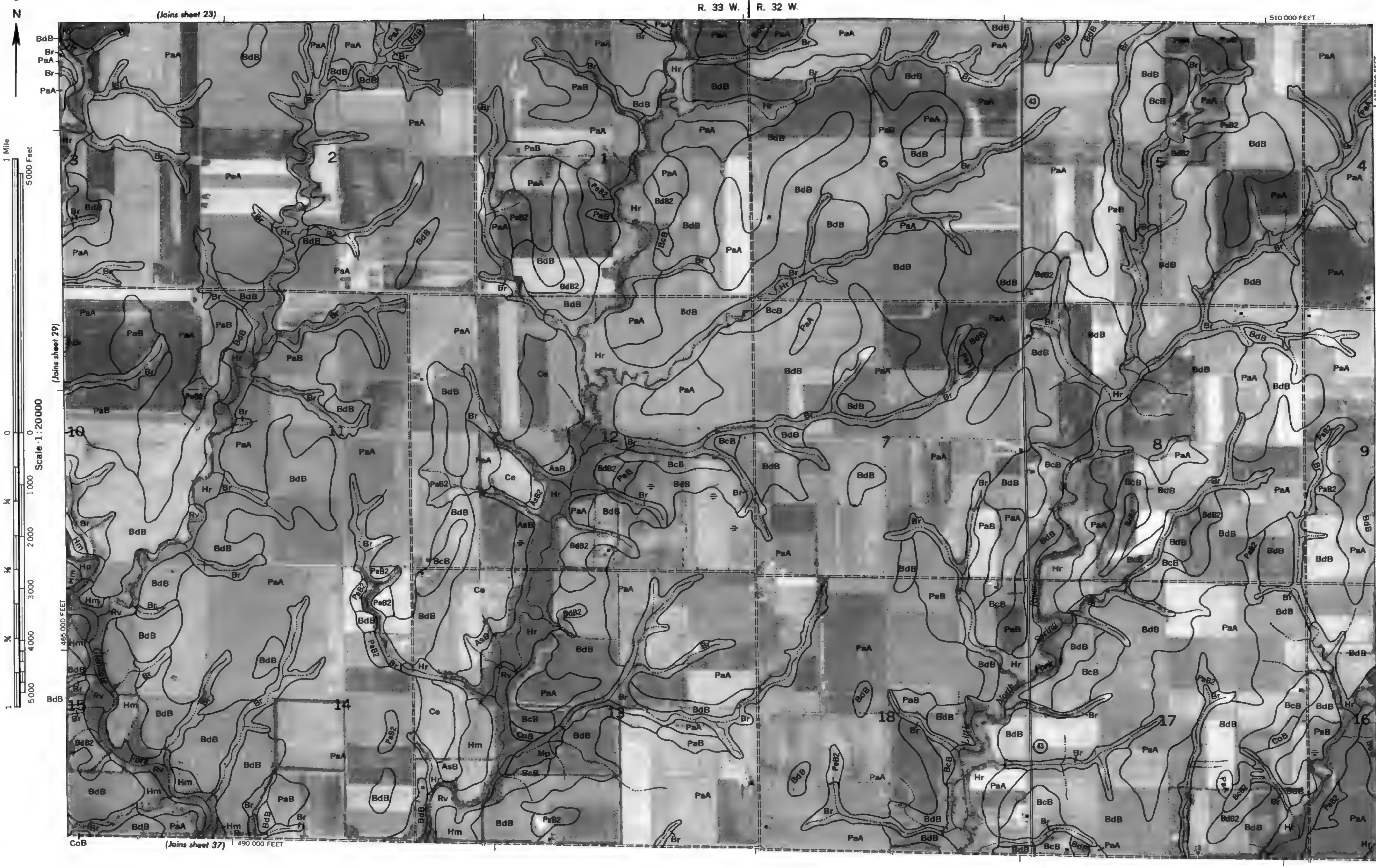
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

BARTON COUNTY, MISSOURI NO. 28

BARTON COUNTY, MISSOURI NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 30



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

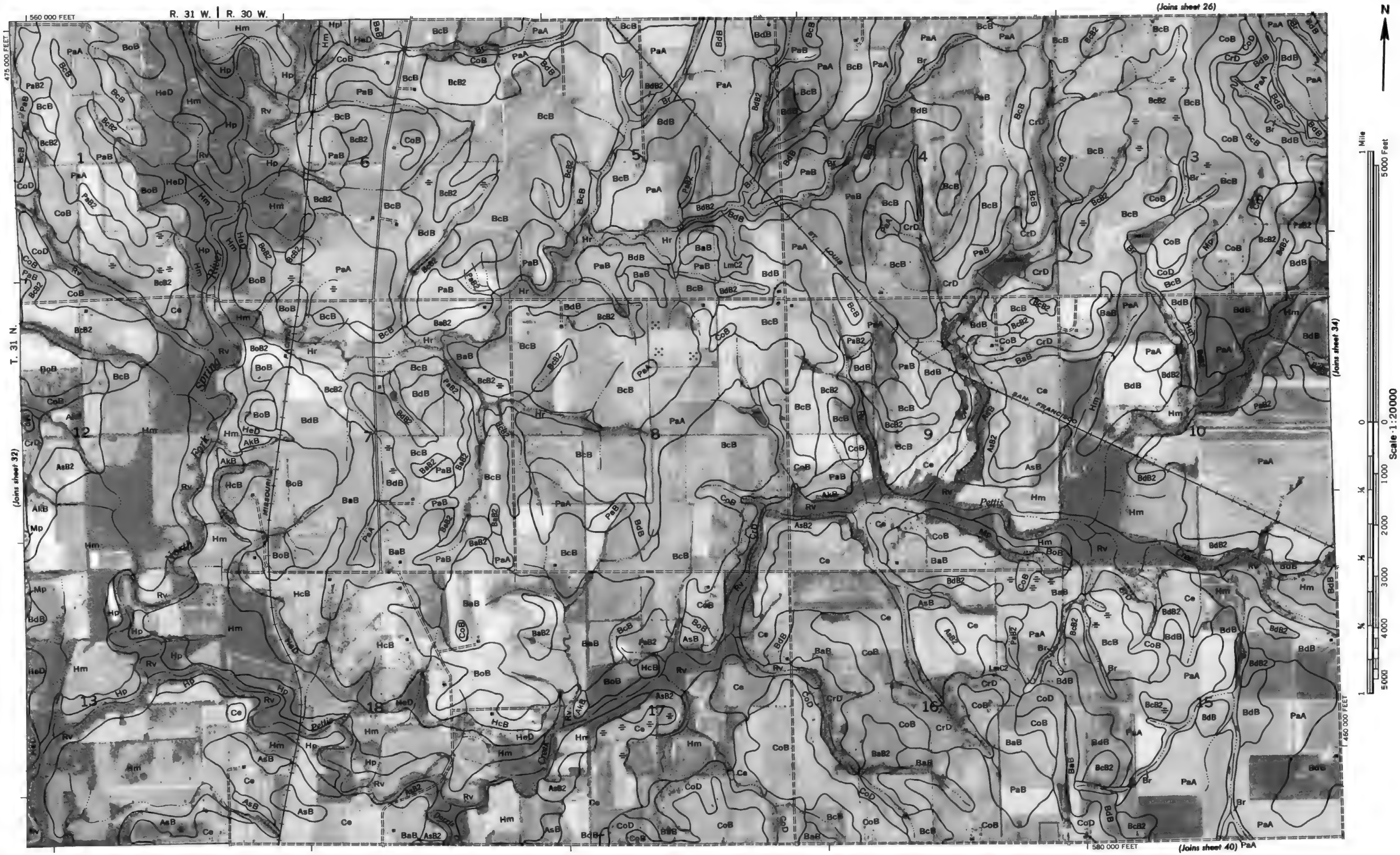

BARTON COUNTY, MISSOURI NO. 31
515 000 FEET
R. 32 W. | R. 31 W.
(Joins sheet 24)
475 000 FEET
T. 31 N.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 38)
535 000 FEET
460 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000

BARTON COUNTY, MISSOURI — SHEET NUMBER 32

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

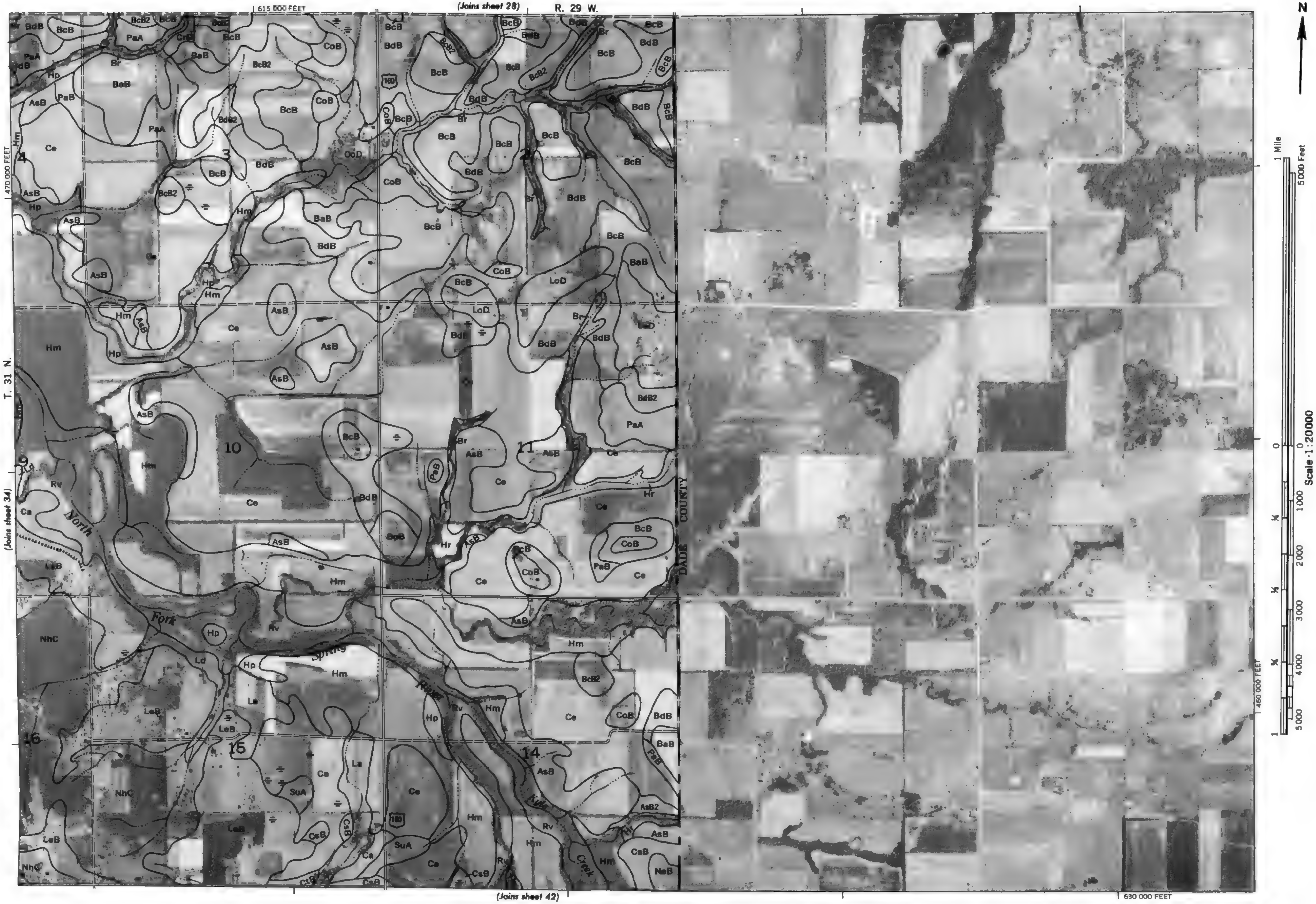
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.


560 000 FEET
R. 31 W. | R. 30 W.
(Joins sheet 26)
N
475 000 FEET
T. 31 N.
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 40)
580 000 FEET
460 000 FEET
Spring River
North Fork
Pettis Creek
ST. LOUIS
SAN FRANCISCO
MISSOURI
1 Mile
5000 Feet
Scale 1:20000

BARTON COUNTY, MISSOURI — SHEET NUMBER 34

BARTON COUNTY, MISSOURI — SHEET NUMBER 35

35



BARTON COUNTY, MISSOURI NO. 35

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 36

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

R. 33 W. | R. 32 W.

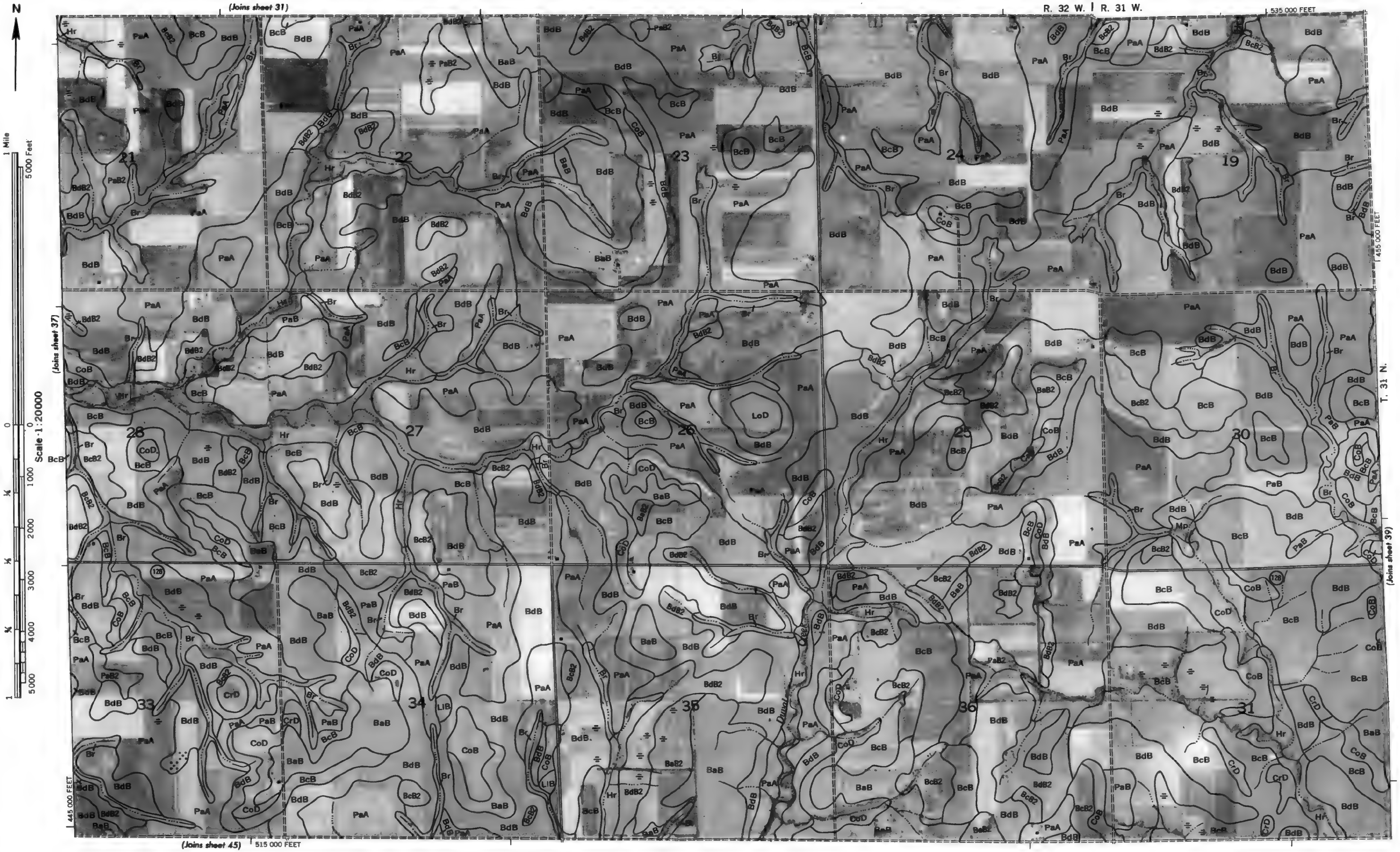
BARTON COUNTY, MISSOURI NO. 37

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

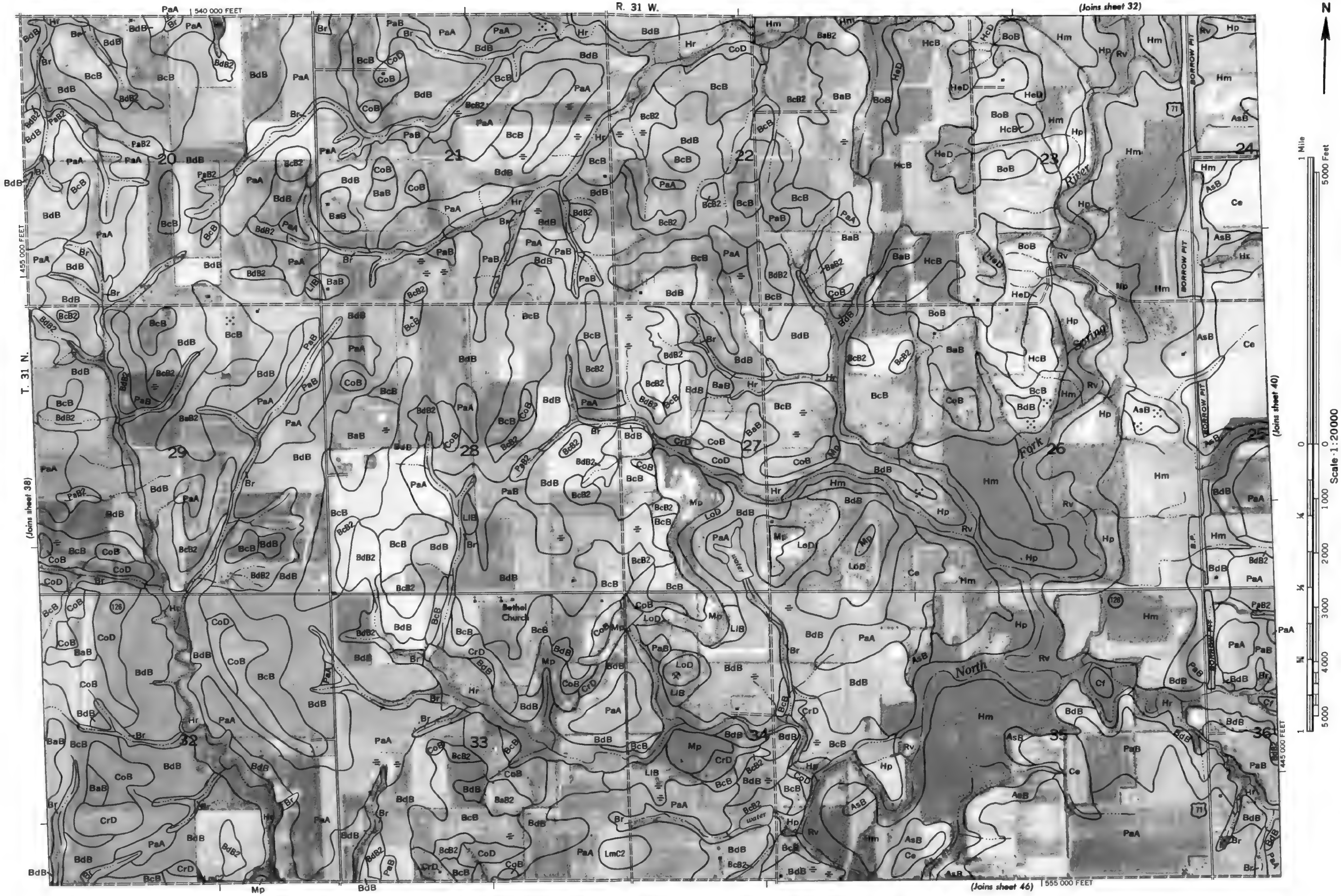
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

Land division corners are approximately positioned on this map.

1 Mile
5000 Feet
Scale 1:20000

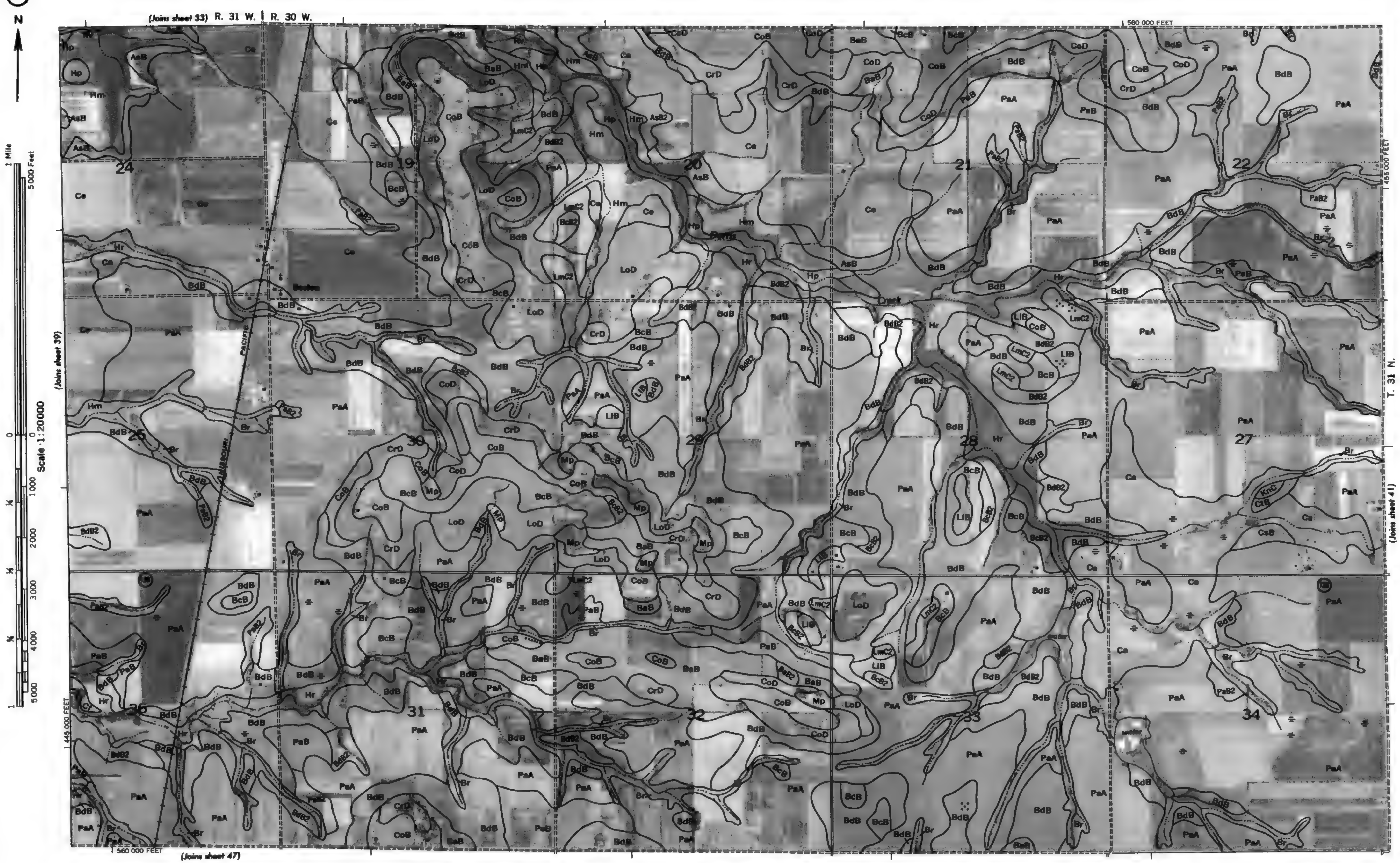


BARTON COUNTY, MISSOURI NO. 38



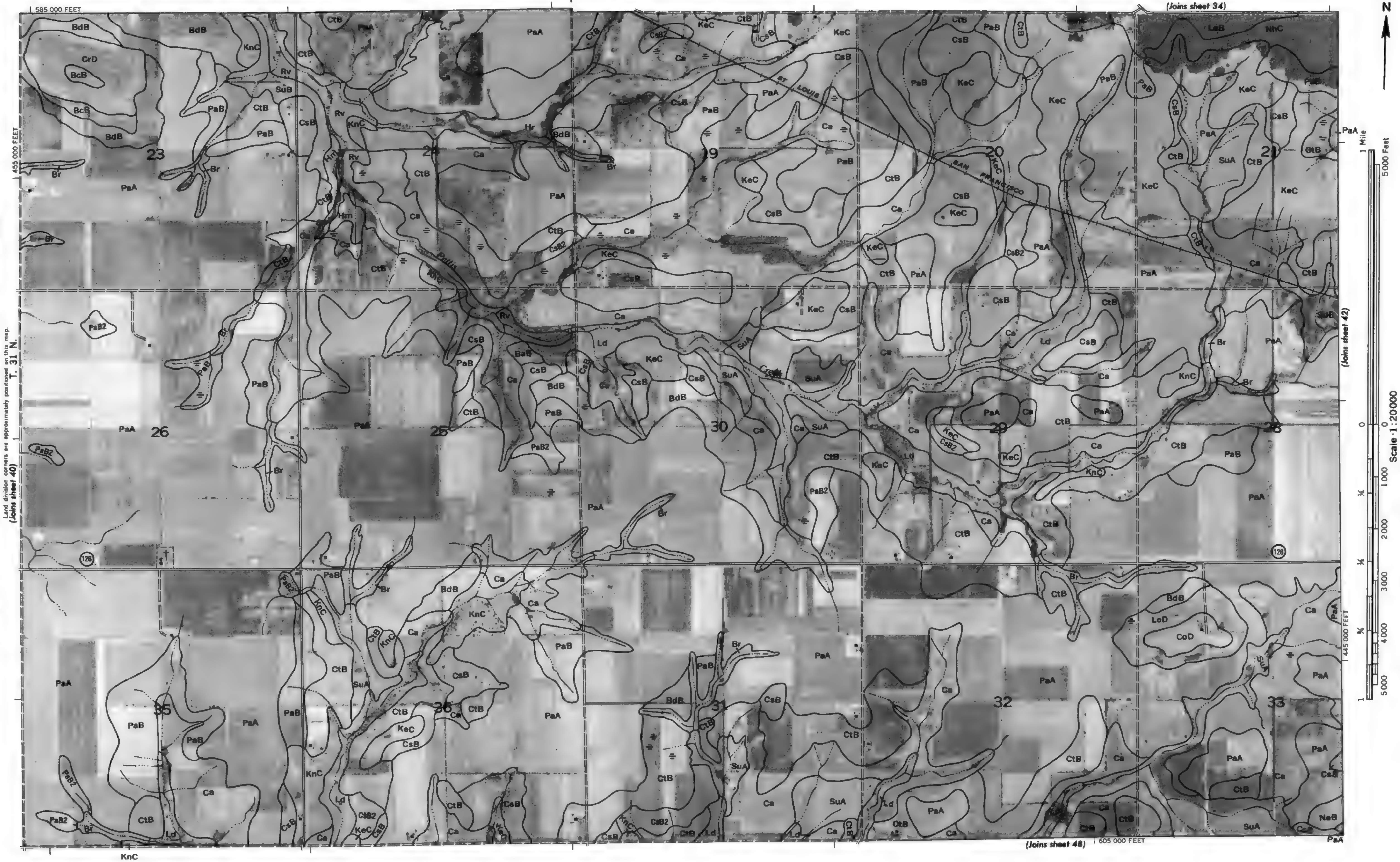
BARTON COUNTY, MISSOURI NO. 39

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.


N
(Joins sheet 33) R. 31 W. | R. 30 W.
580 000 FEET
455 000 FEET
445 000 FEET
560 000 FEET
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 47)
T. 31 N.
1 Mile
5000 Feet
Scale 1:20000
Barton
PACIFIC
MISSOURI
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36

BARTON COUNTY, MISSOURI — SHEET NUMBER 41

(41)



BARTON COUNTY, MISSOURI NO. 41

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 42

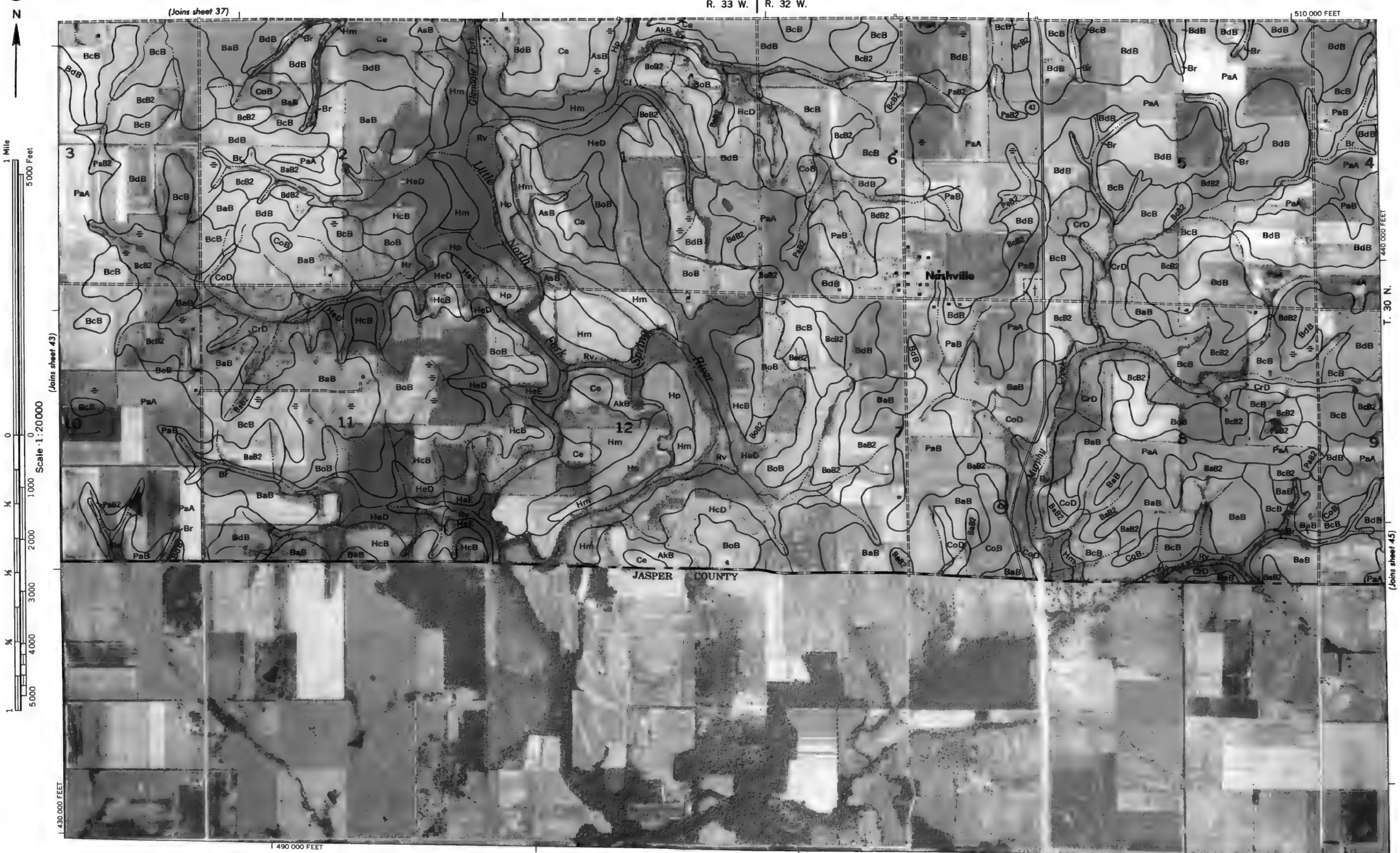
Land division corners are approximately positioned on this map.

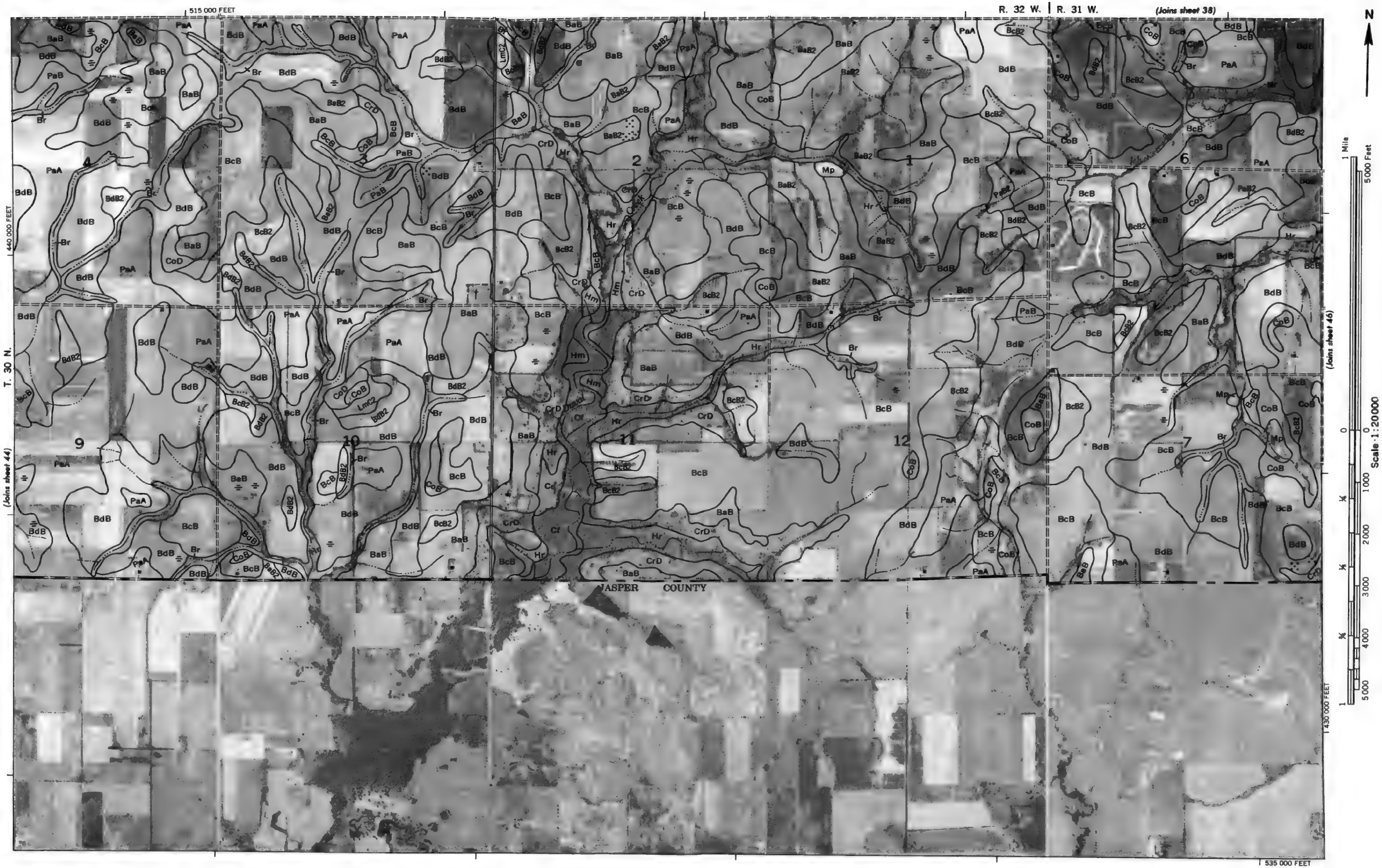
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

BARTON COUNTY, MISSOURI NO. 43

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.


R. 33 W. | R. 32 W.
(Joins sheet 37)
510 000 FEET
(Joins sheet 43)
(Joins sheet 45)
T. 30 N.
440 000 FEET
430 000 FEET
490 000 FEET
Nashville
Little North Fork Spring River
Glendale Fork
Murphy Creek
JASPER COUNTY
N
1 Mile
5000 Feet
Scale 1:20000



BARTON COUNTY, MISSOURI NO. 45

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone. Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 46

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.

BARTON COUNTY, MISSOURI NO. 46

BARTON COUNTY, MISSOURI — SHEET NUMBER 47

47

N

Scale 1:20000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

BARTON COUNTY, MISSOURI NO. 47

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone.
Land division corners are approximately positioned on this map.

BARTON COUNTY, MISSOURI — SHEET NUMBER 48

BARTON COUNTY, MISSOURI NO. 48

BARTON COUNTY, MISSOURI — SHEET NUMBER 49

BARTON COUNTY, MISSOURI NO. 49

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Missouri Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Missouri coordinate system, west zone. Land division corners are approximately positioned on this map.